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# ELECTRICAL REVIEW

FRIDAY
2 DECEMBER 1961

WEEKLY
PRICE 1s 6d

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BRITISH INSULATED CALLENDER'S CABLES LIMITED
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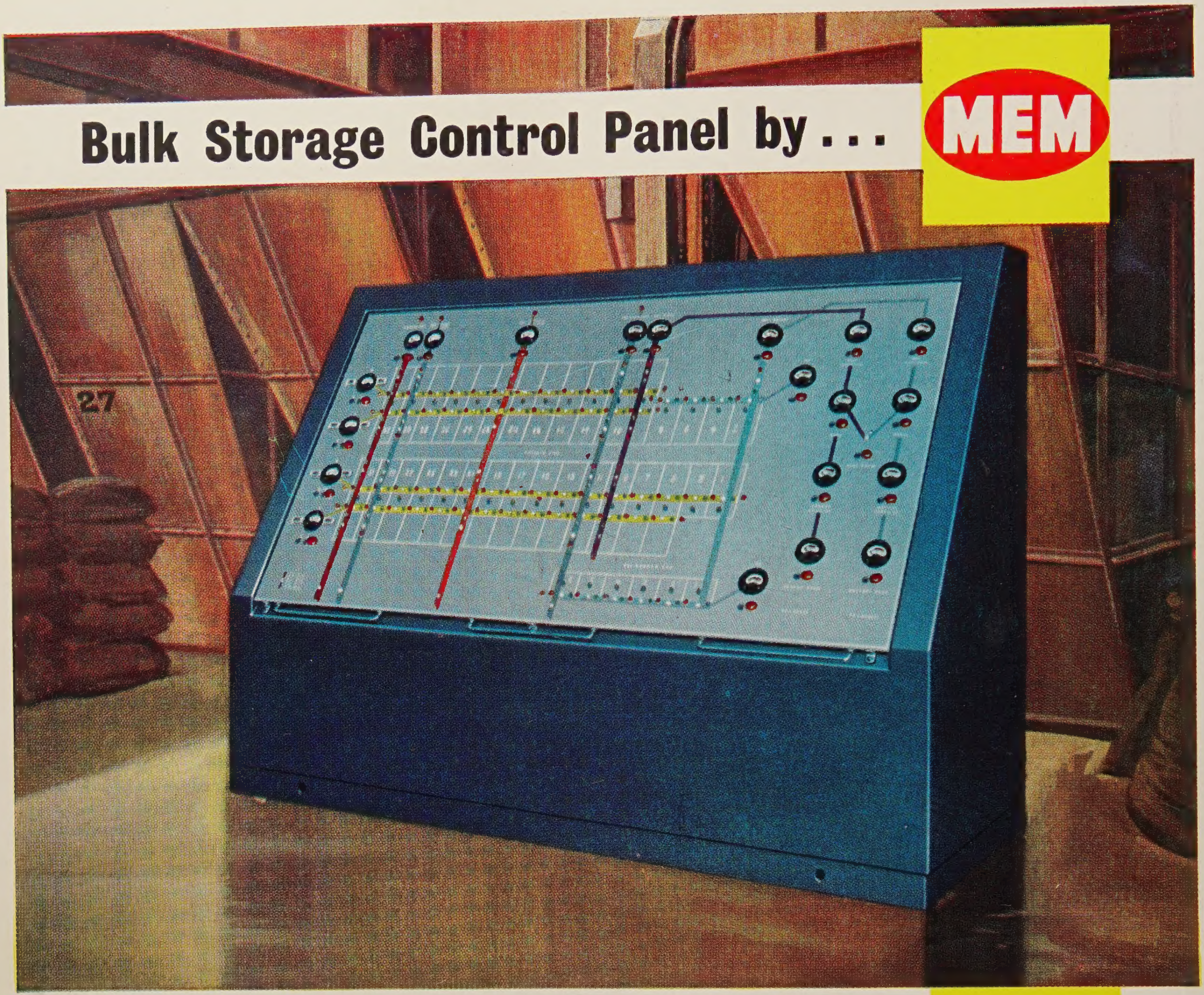
# Bulk Storage Control Panel by . . . MEM



The panel is designed to control a number of conveyors operating a bulk storage plant consisting of 33 bins of 7½ tons capacity each.

Each bin has a pneumatically operated slide controlled by a solenoid operated air valve, making it possible to route material from any intake position to any one of the bins.

The panel comprises contactors controlling the solenoid air valves and starters with ammeters for the conveyor motors, dust extractor, etc. Full electrical interlocking of the conveyors and various safety features have been incorporated in the control circuits.

The mimic diagram on the sloping front of the panel gives a clear indication of the state of the plant which extends over an eight storey building. The position of the 100 slides is shown by means of indicator lights. In the event of any dangerous condition arising, an alarm signal is sounded and visible warning is given by flashing lights showing the position of the blockage.

The circuit was developed in co-operation with Mr. G. S. Carr, A.M.I. Mech.E., A.M.I. Plant E., Chief Engineer of Messrs. Crosfields and Calthrop Ltd., manufacturers of animal and poultry foodstuffs.

**MEM** MIDLAND ELECTRIC MANUFACTURING CO. LTD., TYSELEY, BIRMINGHAM, 11.

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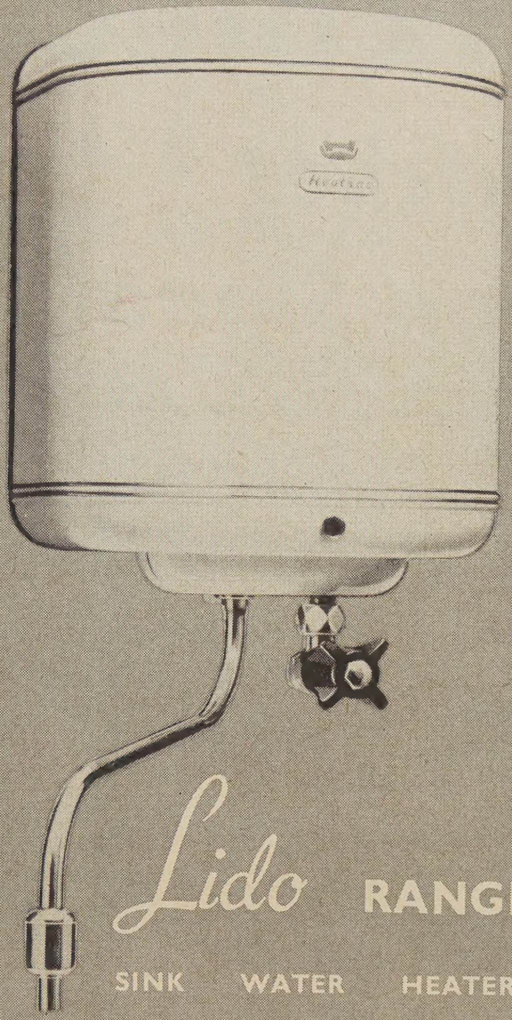
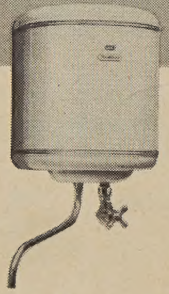
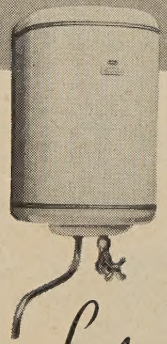


EVERY ONE OF THE *Lido* RANGE

OF AUTOMATIC ELECTRIC SINK WATER HEATERS





*Lido* **EXPRESS**

*(Illustrated above)*

**1½ Gallons. 3000 watts.**

*Lido* **1·5**

**1½ Gallons. 1000 watts.**

*Lido* **2·2**

**2·2 Gallons. 1000 watts.**

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**3 Gallons. 2000 watts.**

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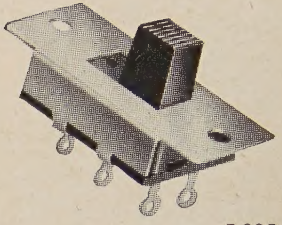
## Neon Signal Lamps



T.225

**T.225**: Miniature Slide Switch
For Portable Radios, D.P.D.T.

**S.L.190** and **S.L.50**:
Snap-in Fixing Neon Indicators.

**S.L.162**: Waterproof Neon Indicator.

**A.56**: Door Switch for Refrigerators.
Snap-in fixing.

**G.605**: Toggle Switch,
New style spade dolly.

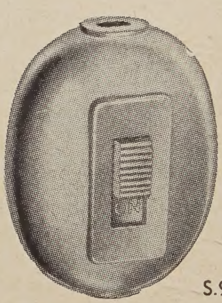
**S.260**: All insulated 15-amp. Switch.

**C.S.200**: 15-amp. 4 Position Rotary Switch,
Double pole 3-heat control for cookers.

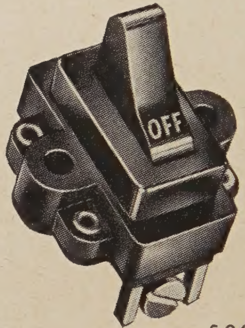
**S.952**: Miniature Line Cord Switch.

**S.960**: Spin Dryer Switch.

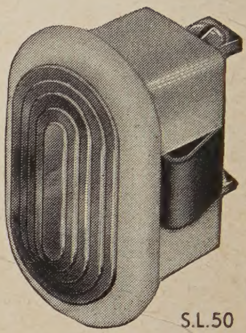
*Write for latest Catalogue*



S.952

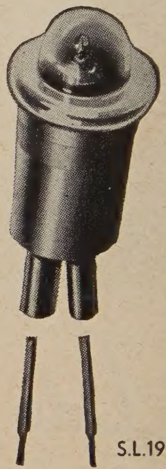


S.260



S.L.50

S.L.162



S.L.190

## Arcolectric Switches Ltd.

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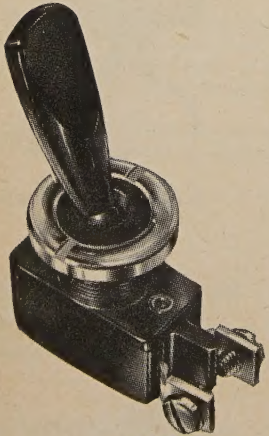
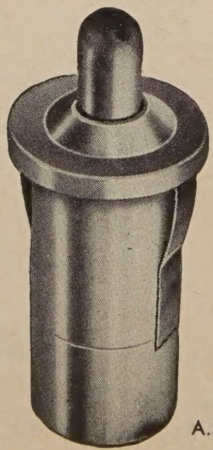
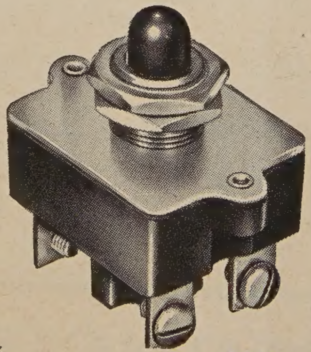


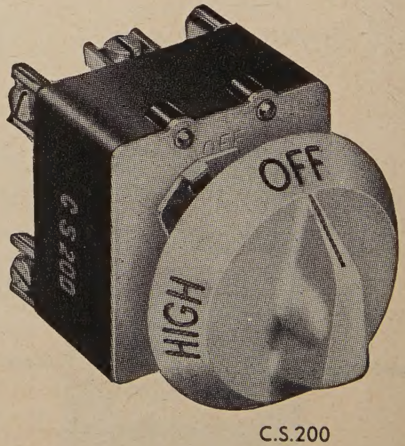
G.605



A.56



S.960



C.S.200

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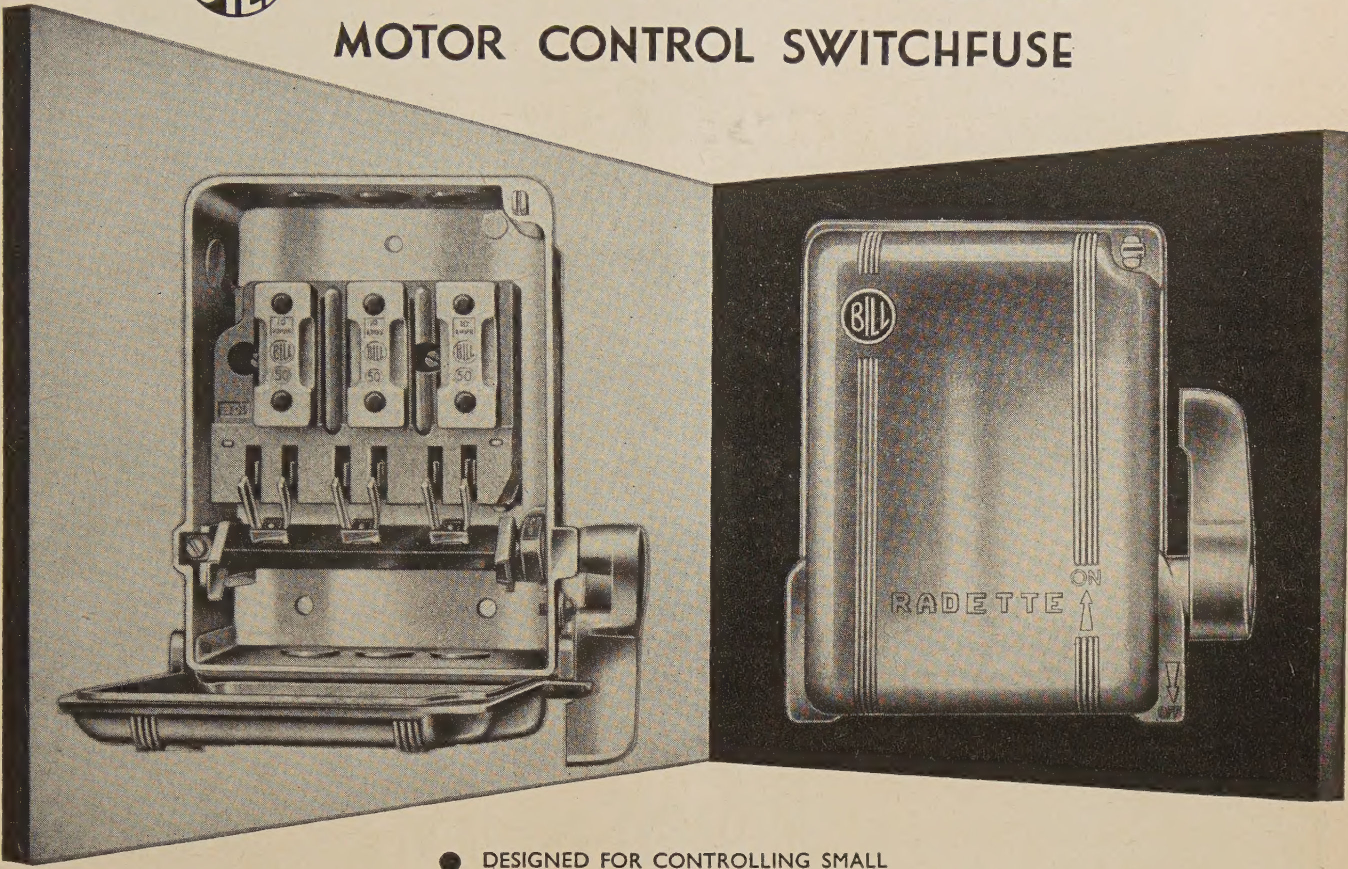
## MOTOR CONTROL SWITCHFUSE



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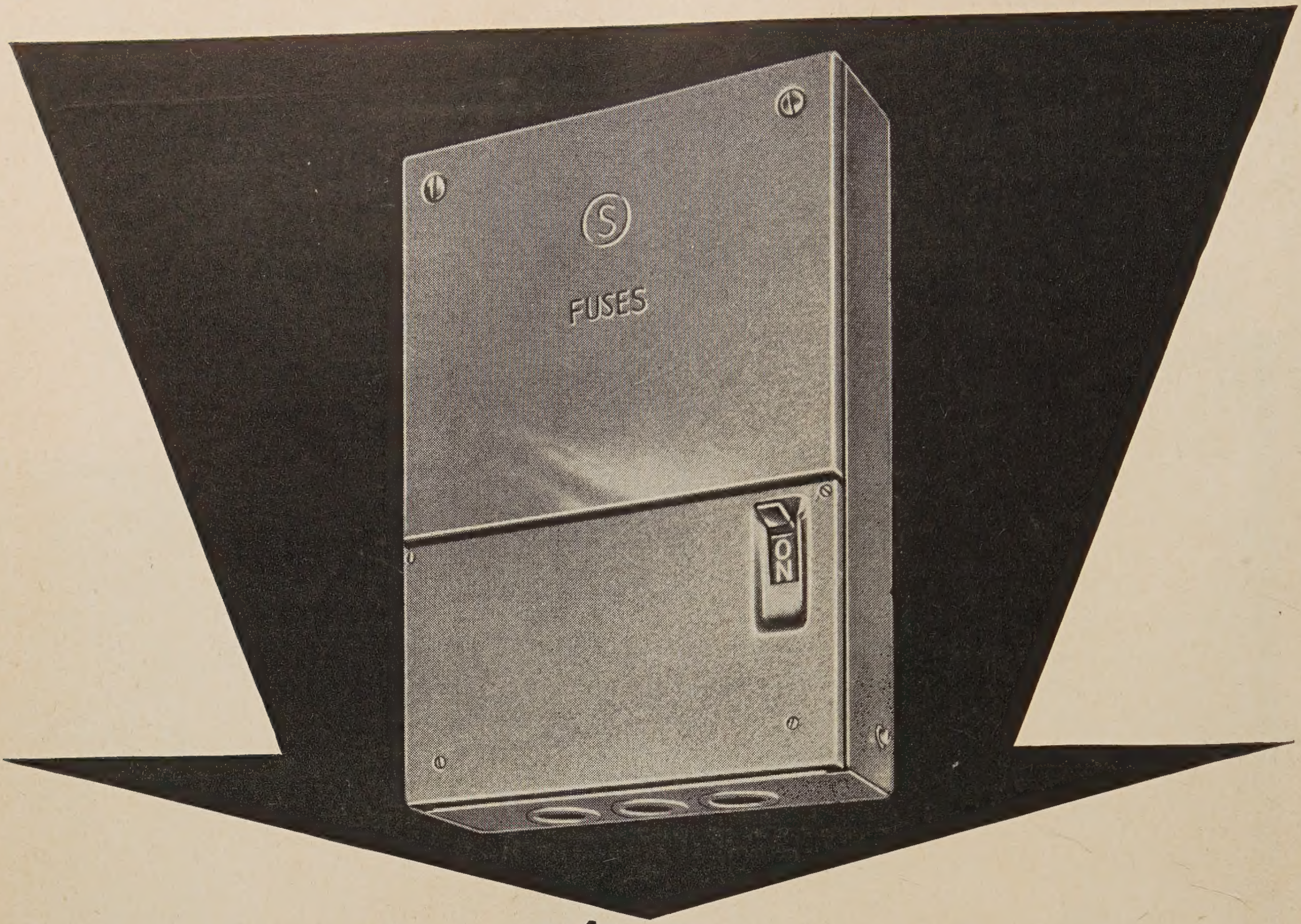

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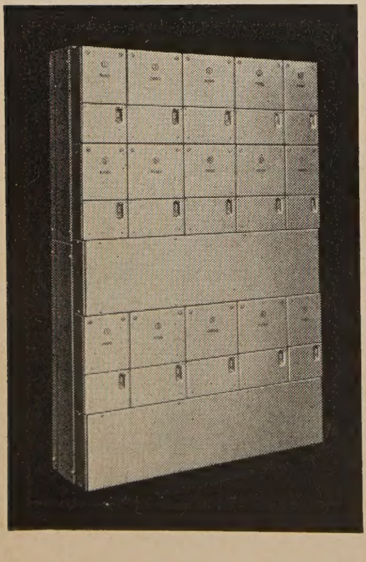

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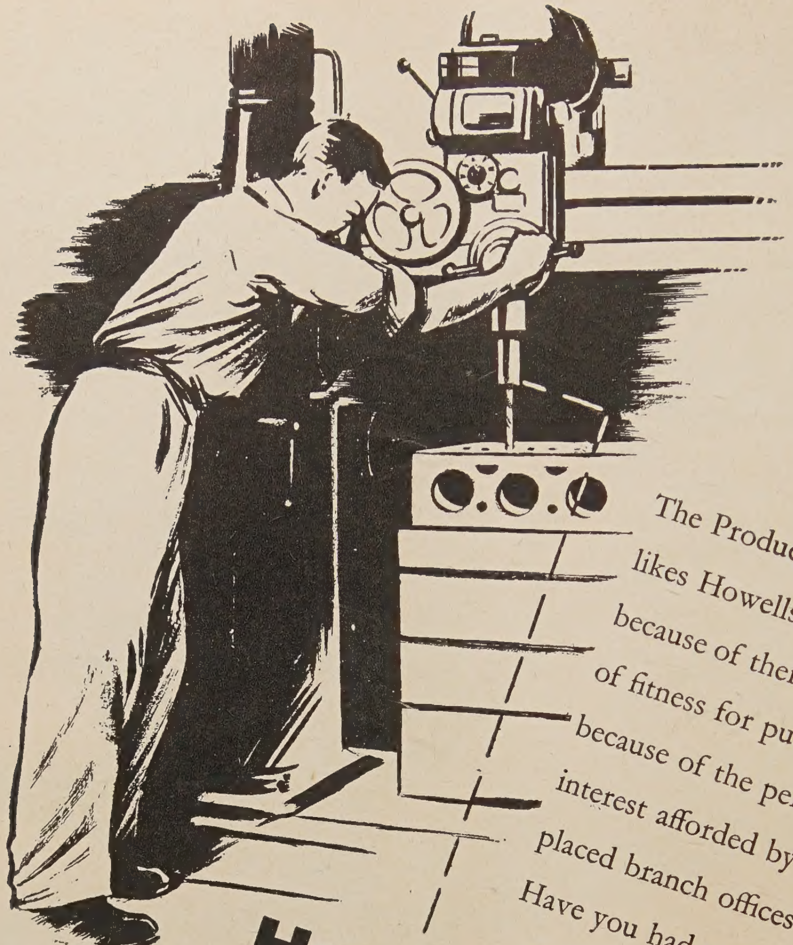

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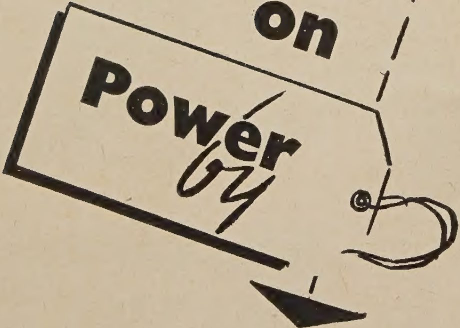

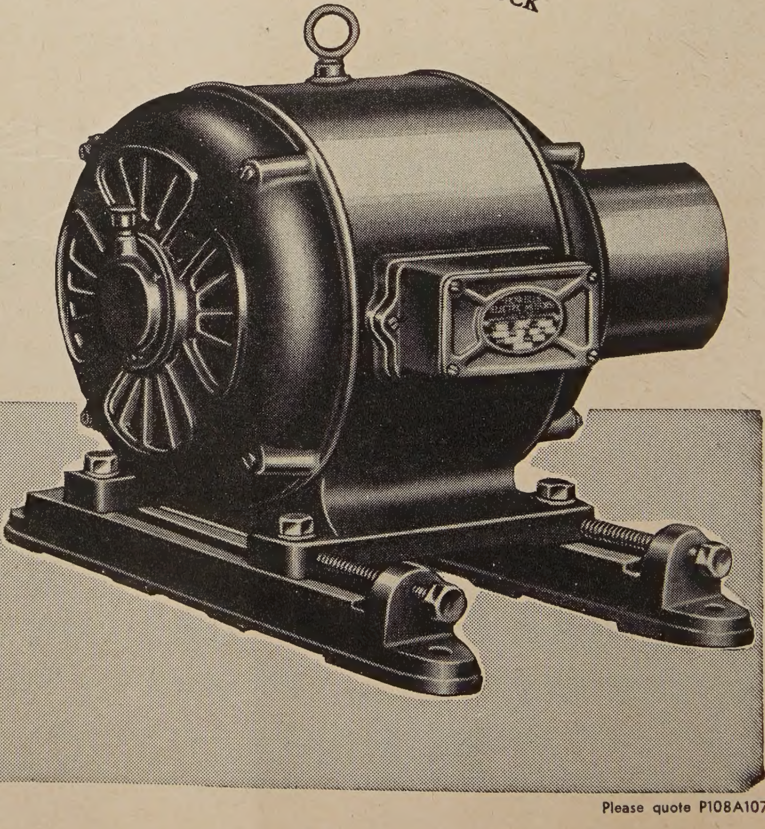

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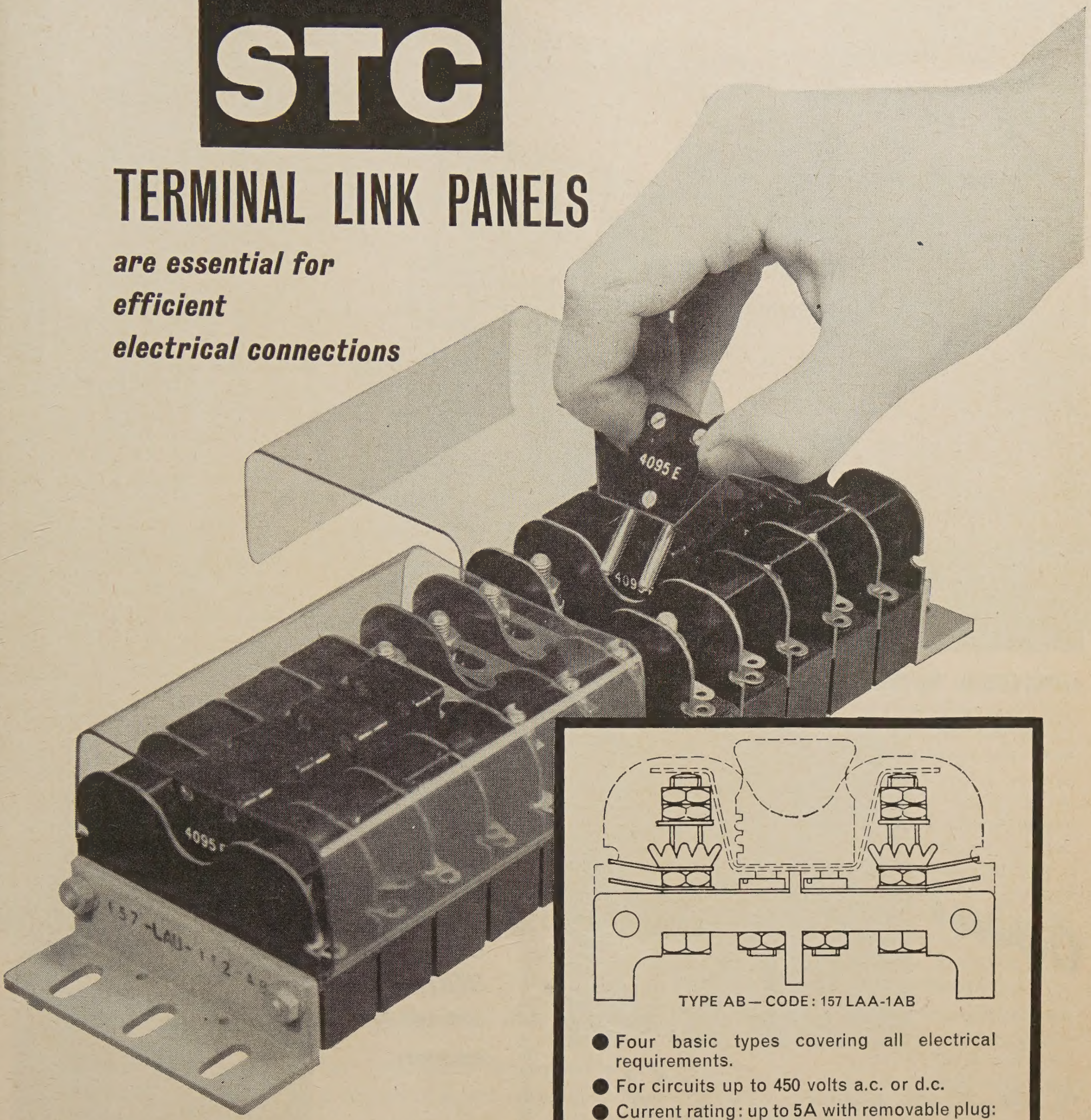

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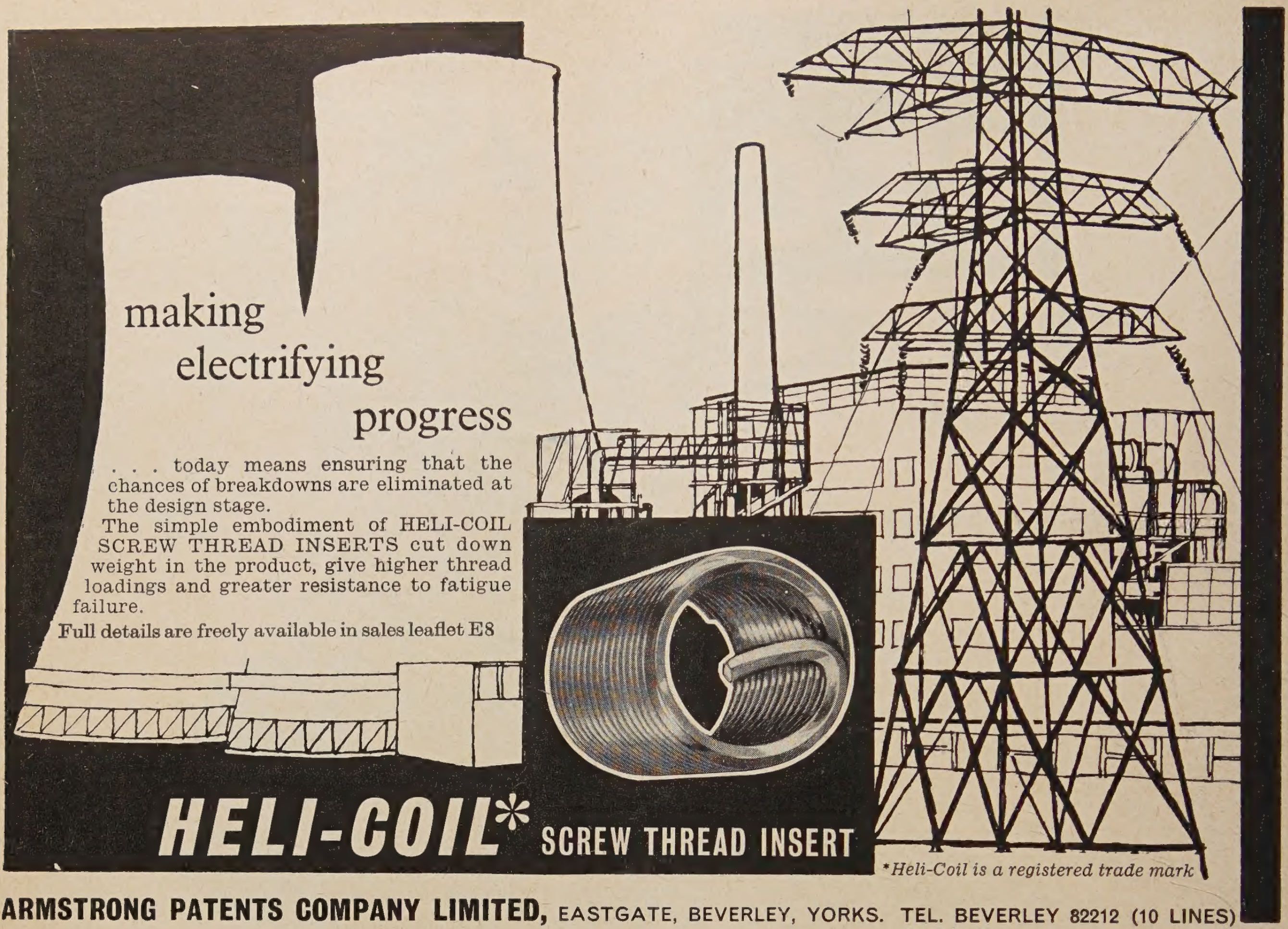

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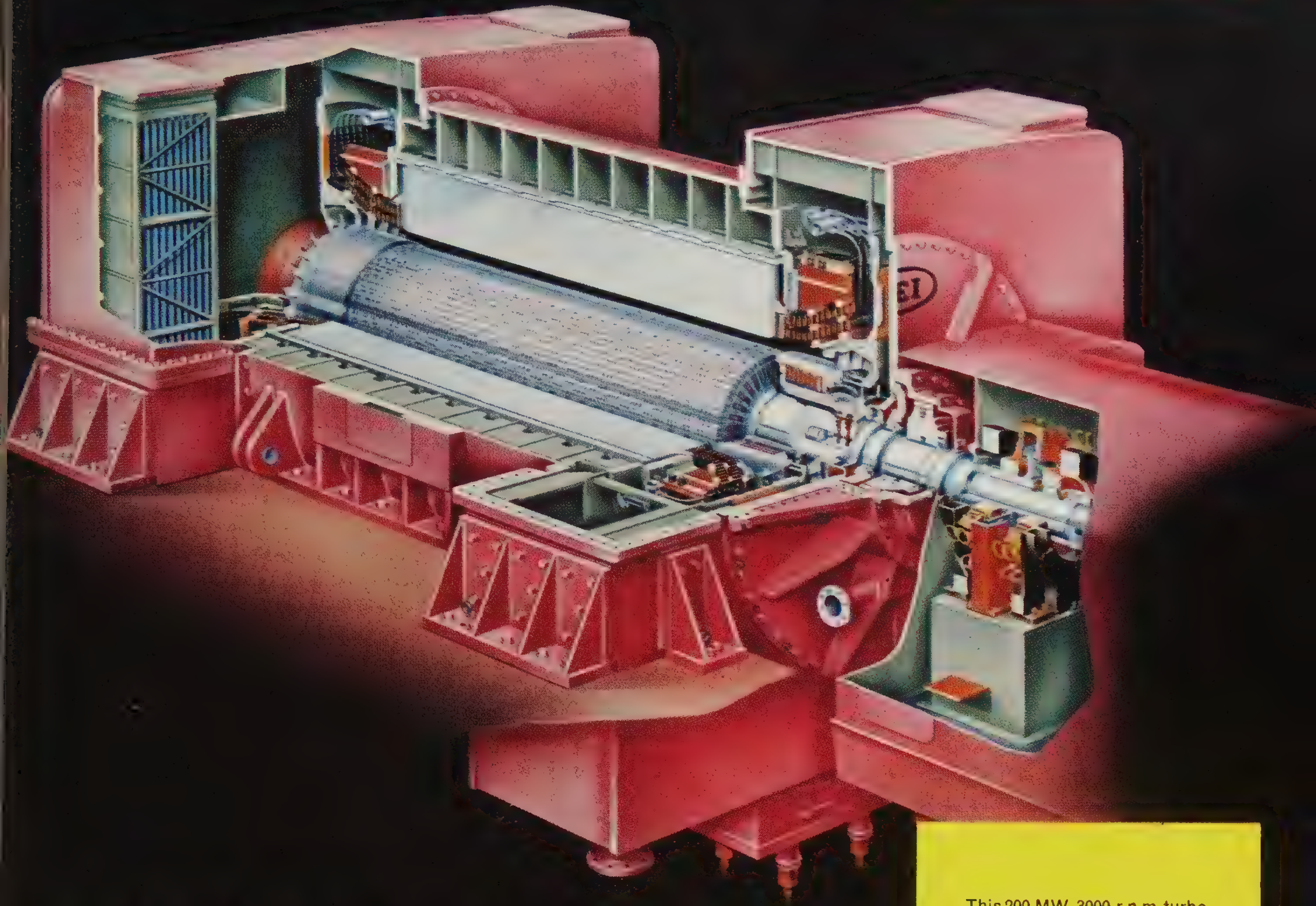

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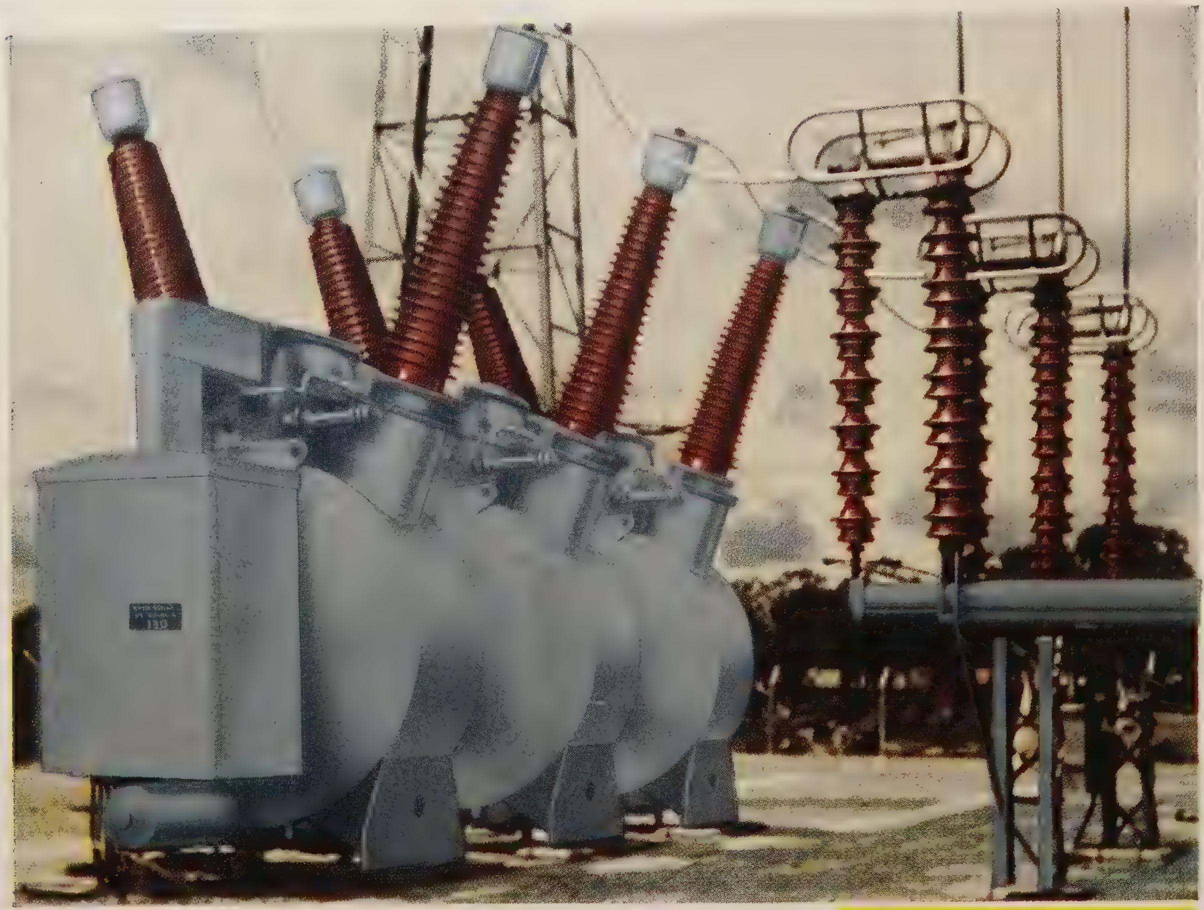
# AEI Switchgear at KARIBA



*Type JW421, 330-kV, 7,500 MVA Oil Circuit Breaker at KITWE Substation, Kariba Hydro-electric Scheme. Consulting Engineers:- Messrs. Merz & McLellan.*

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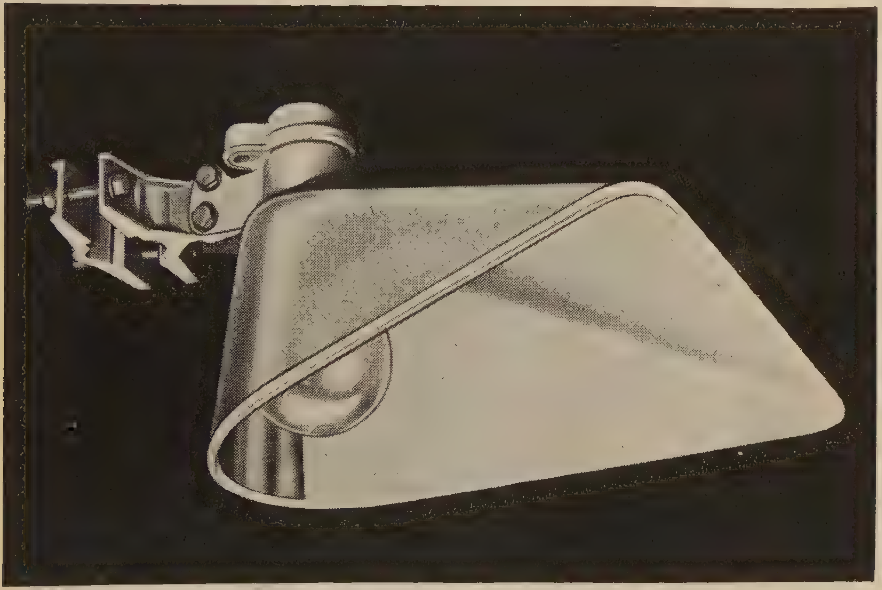

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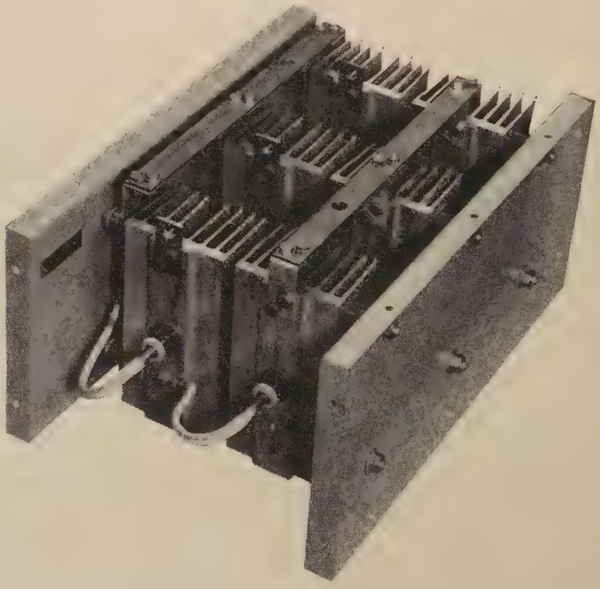

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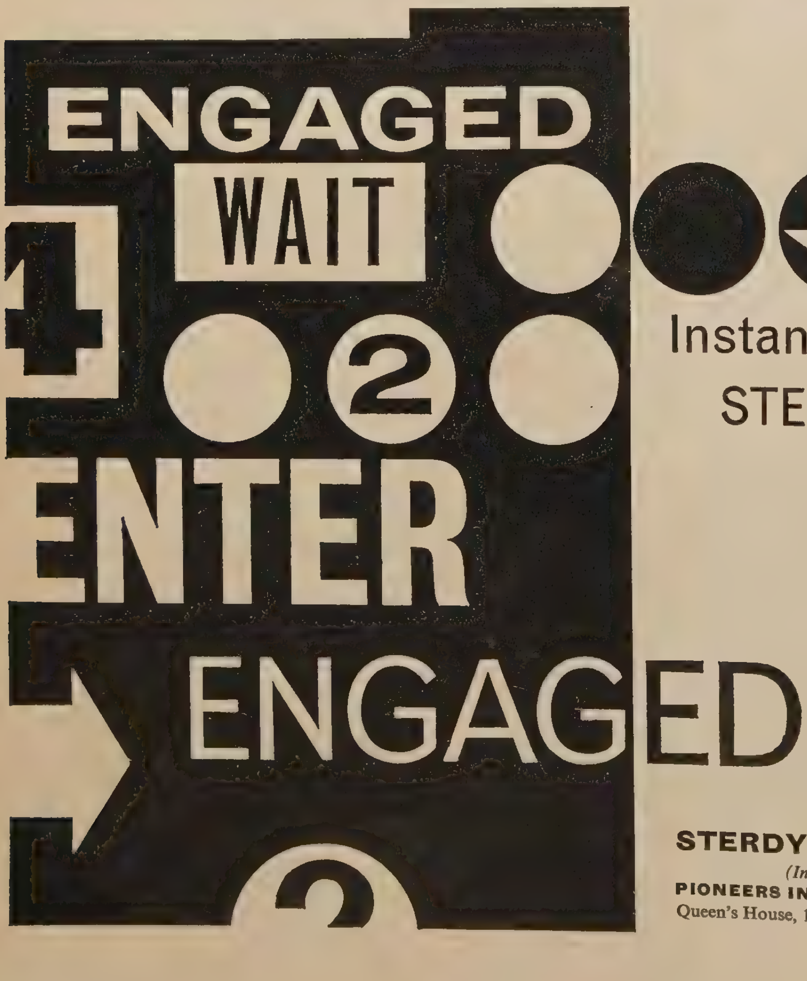

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# RECTIFICATION

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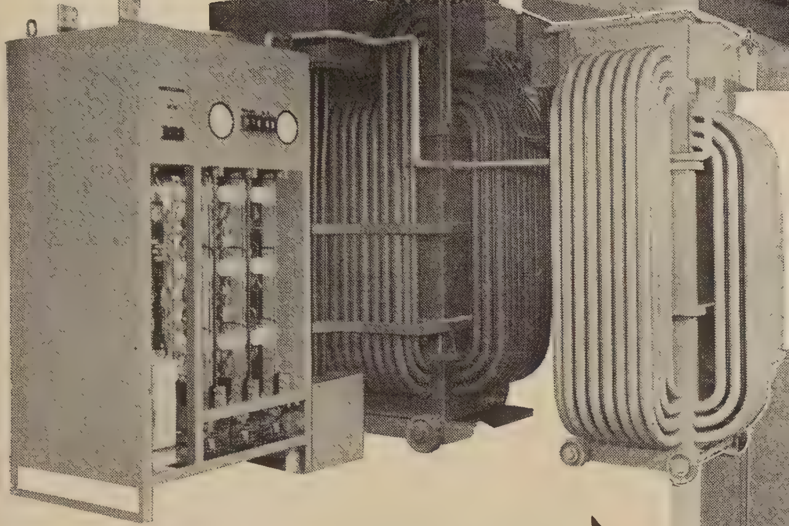

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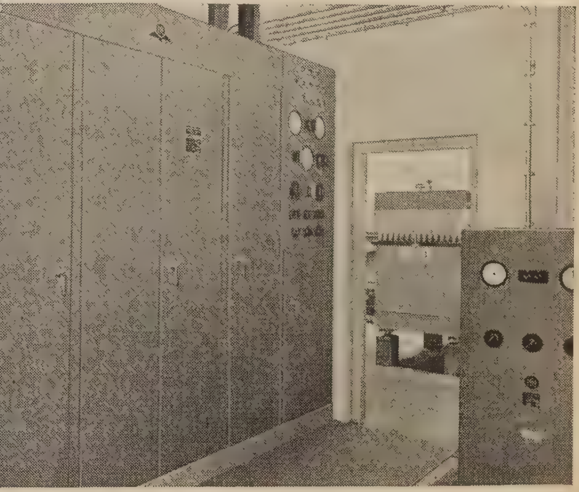

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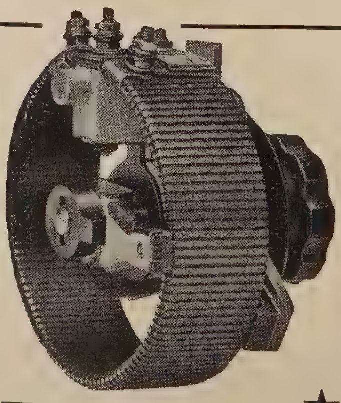

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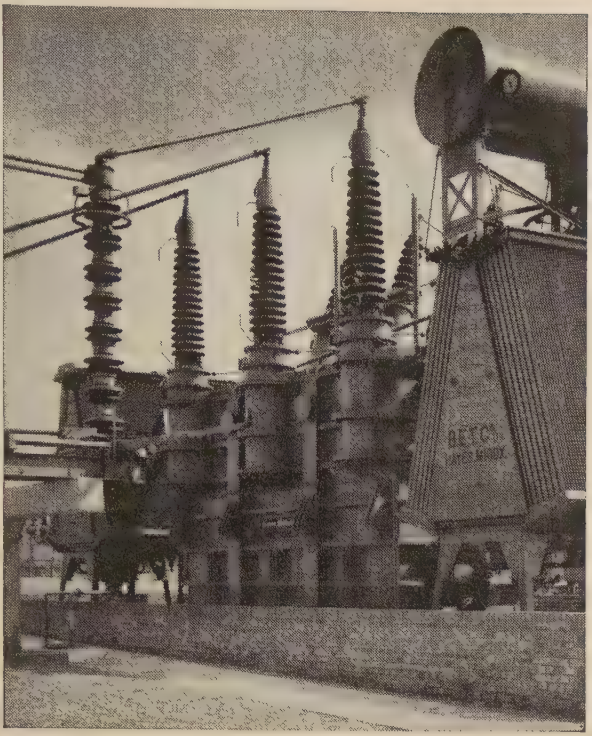

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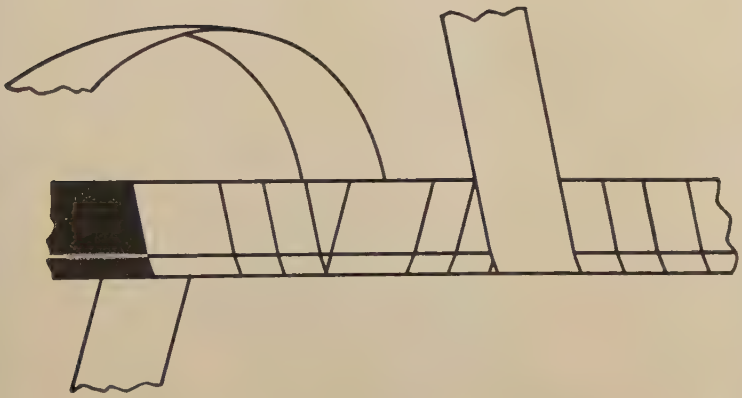

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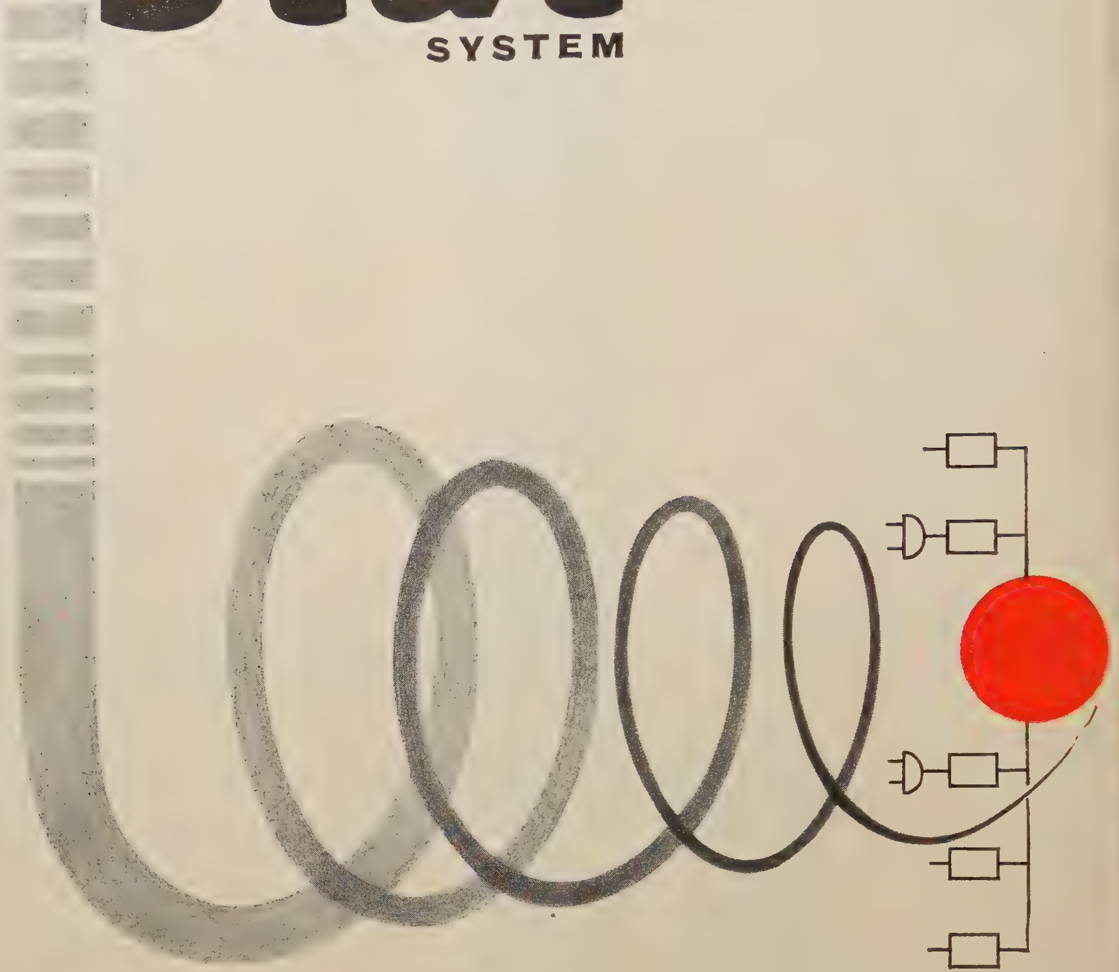

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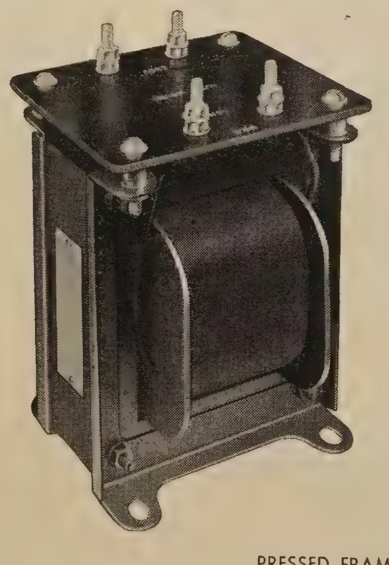

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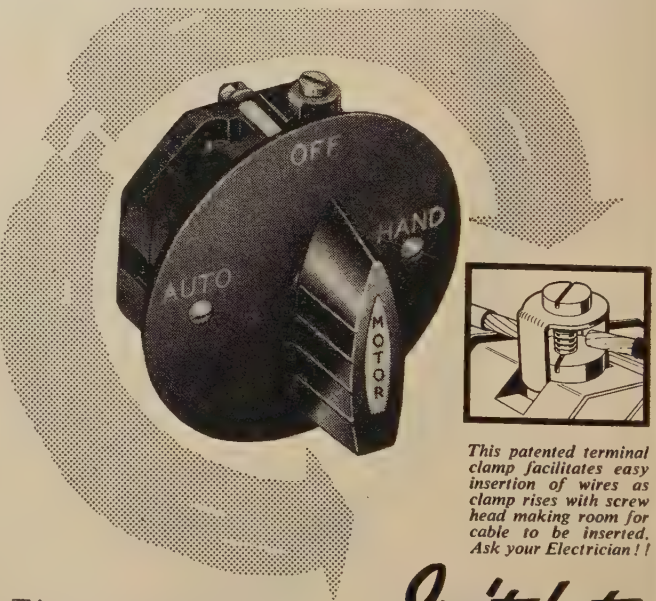

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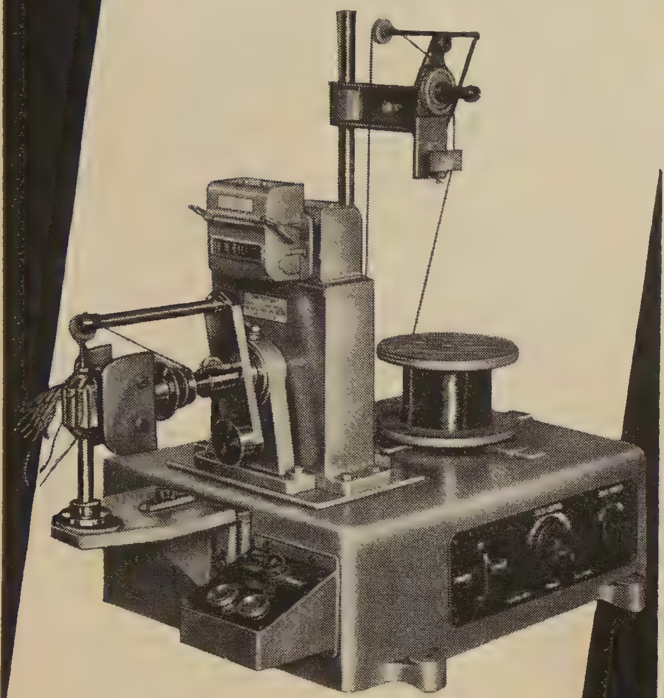

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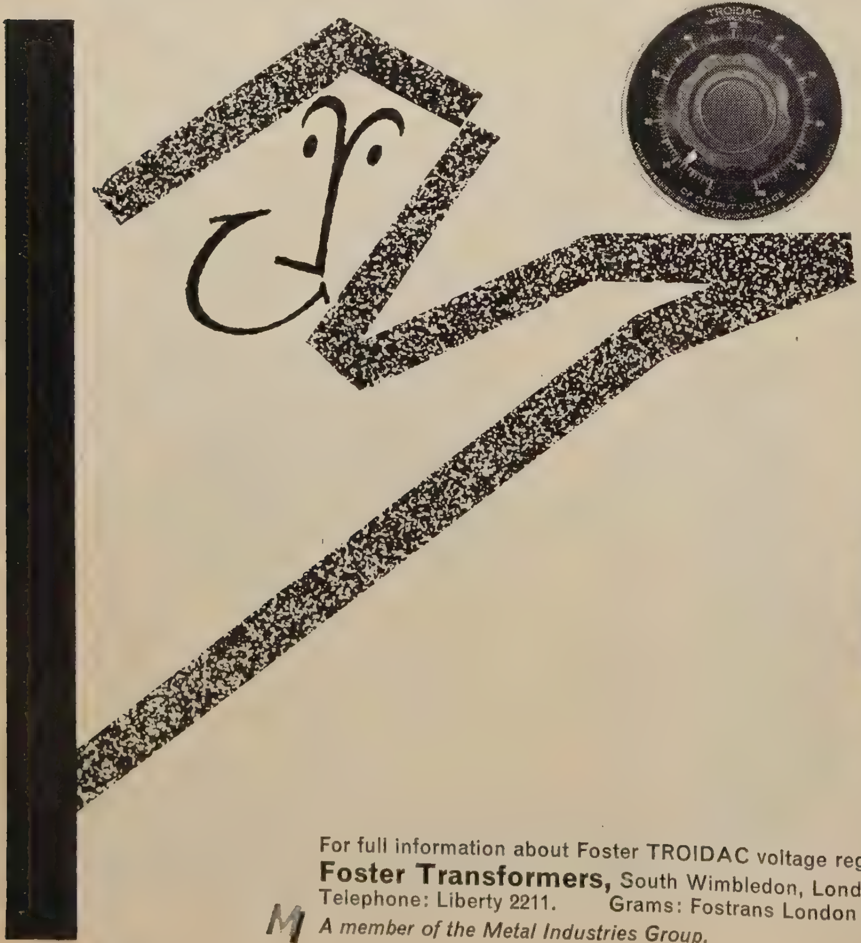

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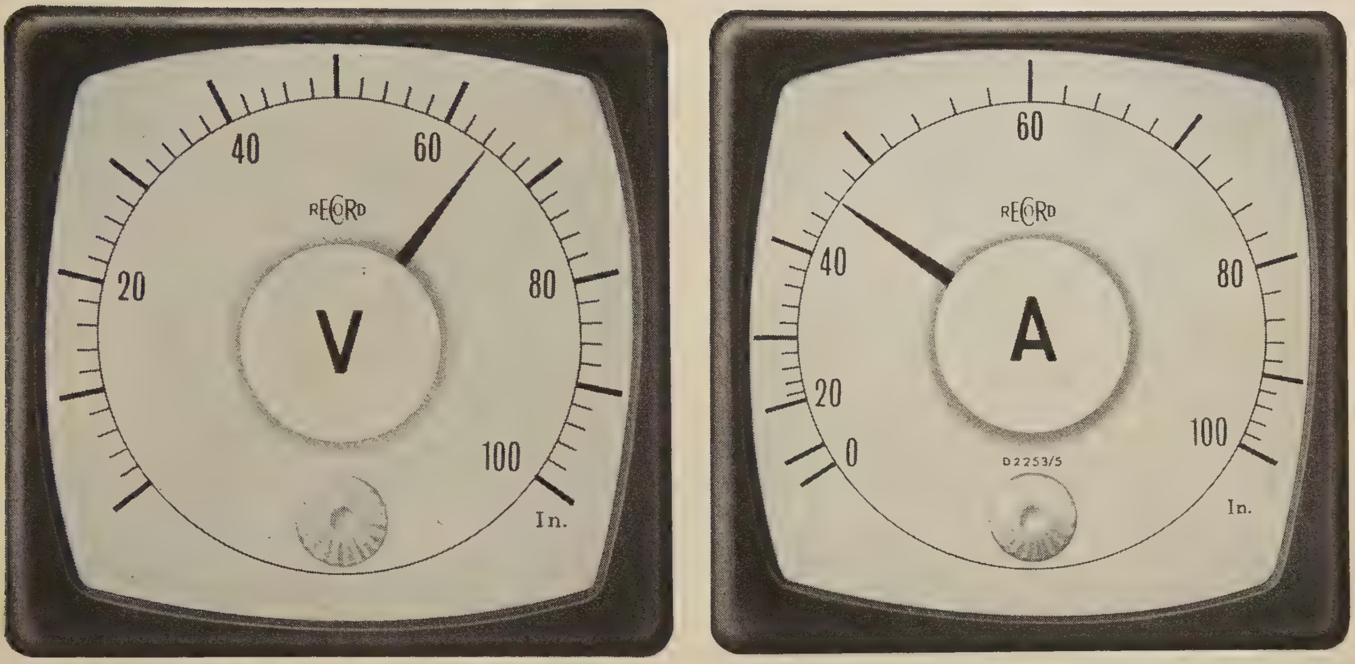

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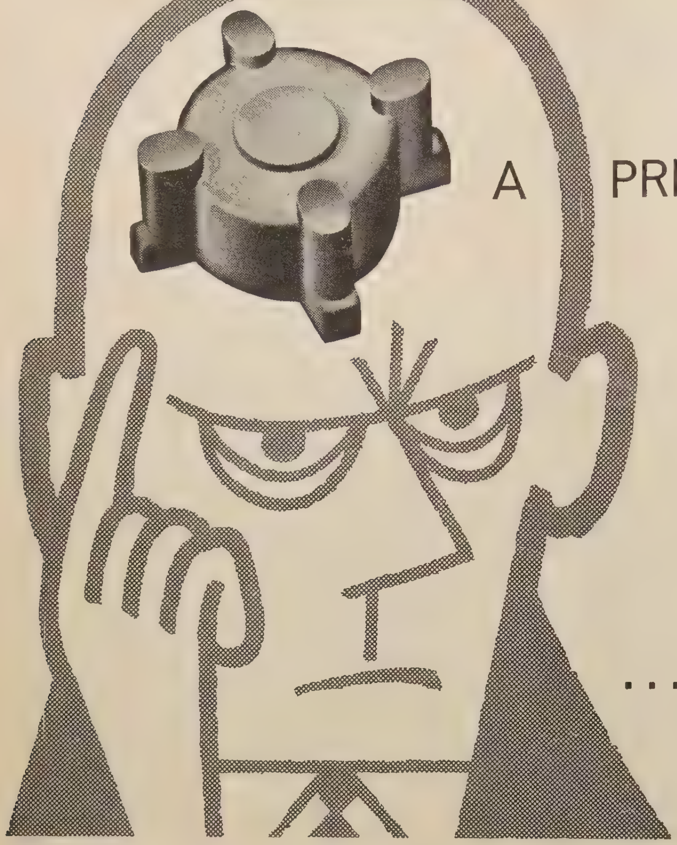

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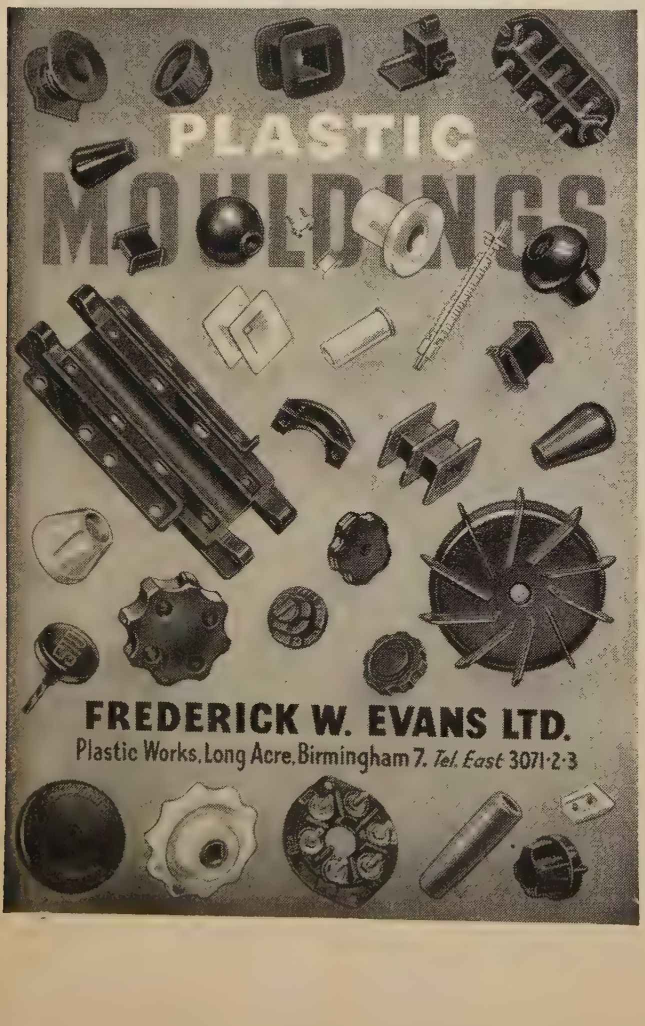

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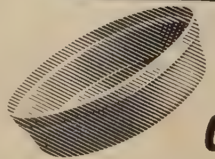

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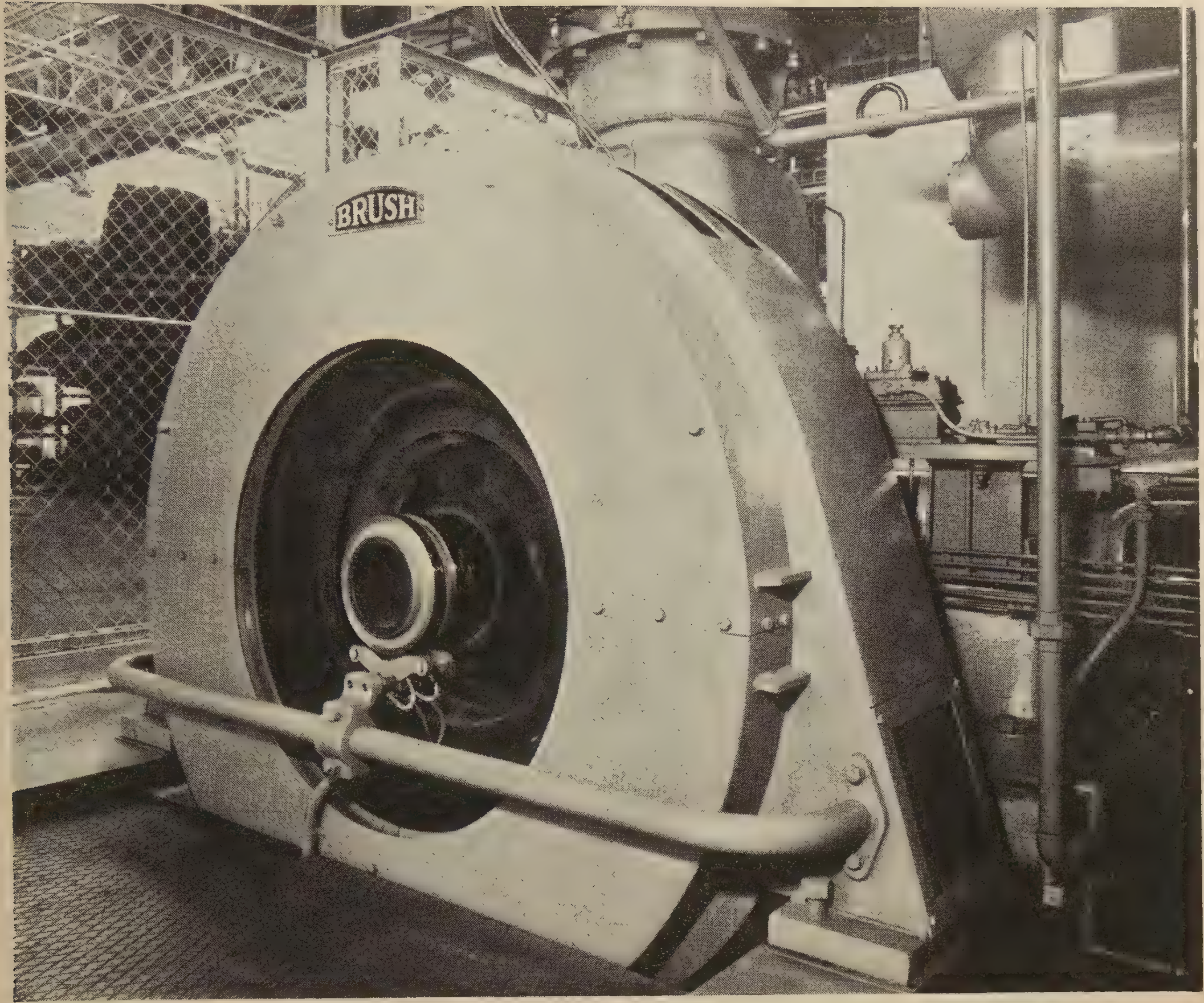

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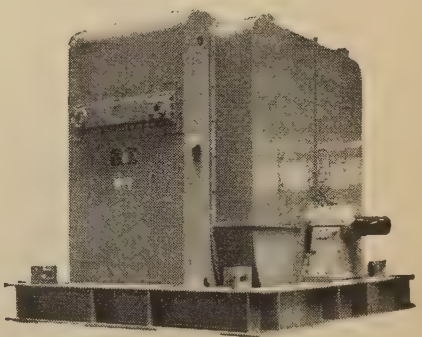

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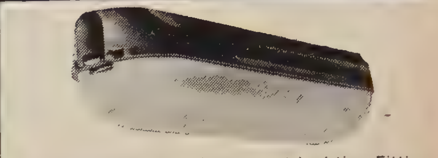

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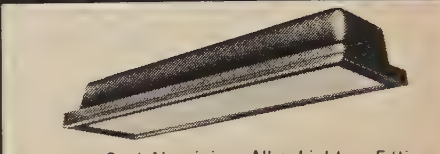

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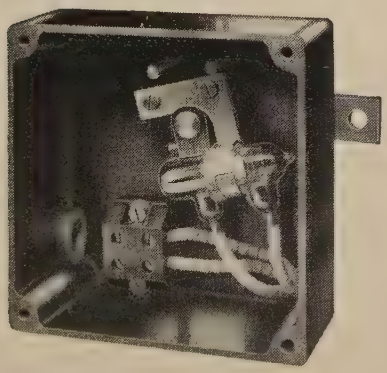

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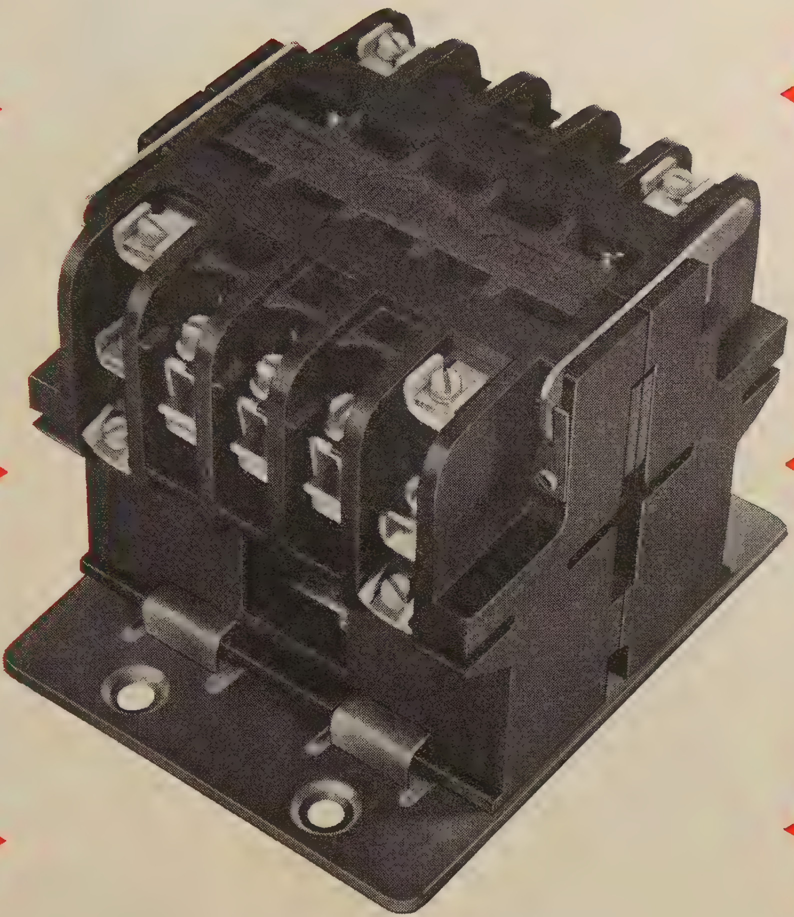

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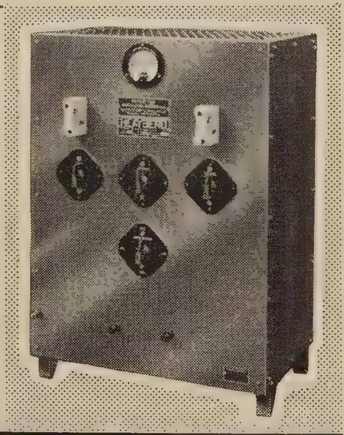

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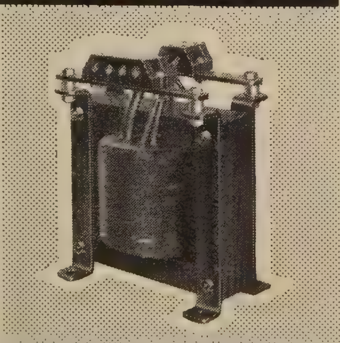

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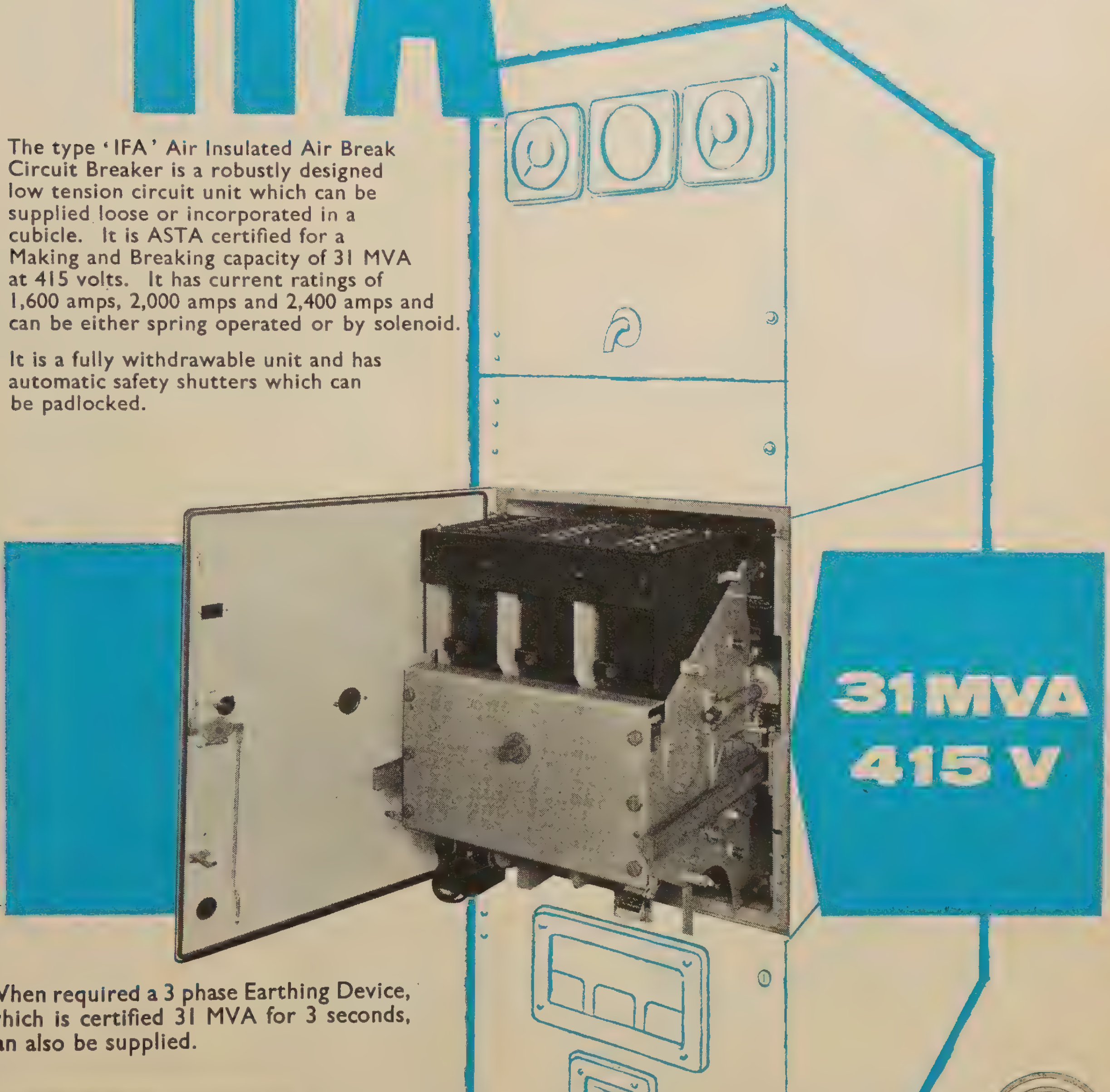

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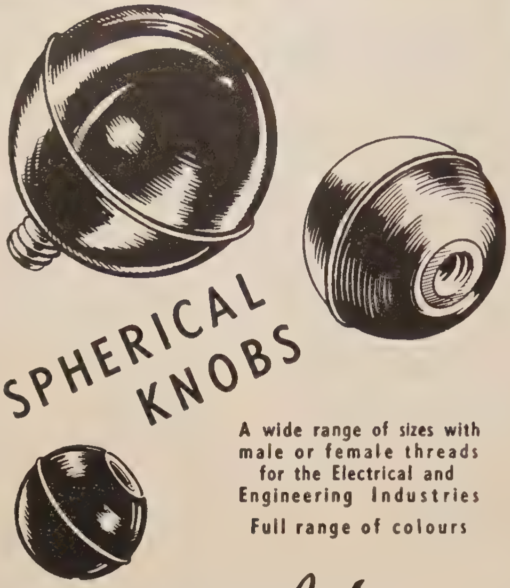

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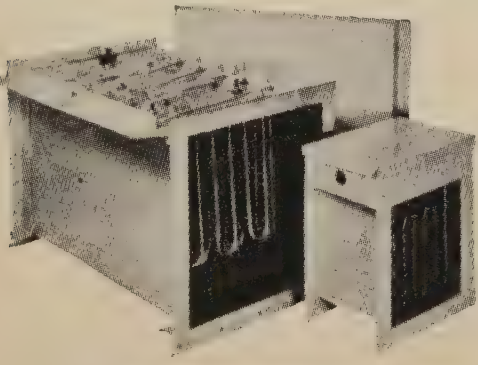

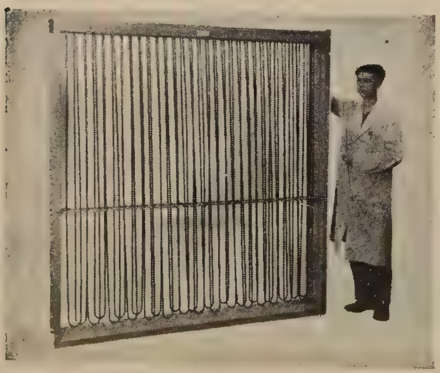

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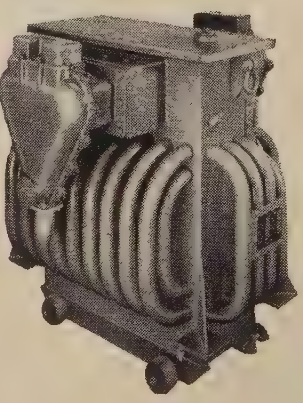

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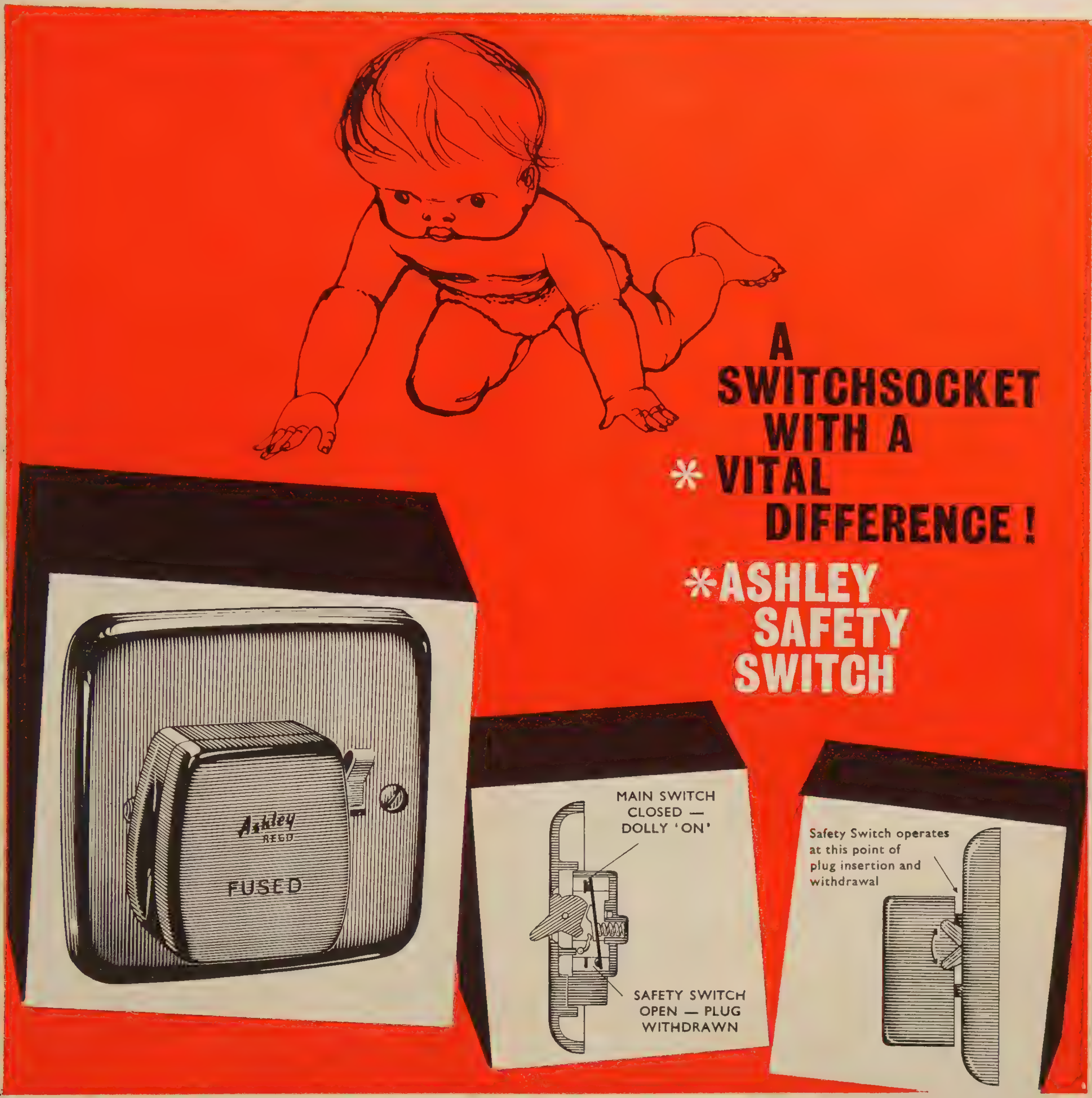
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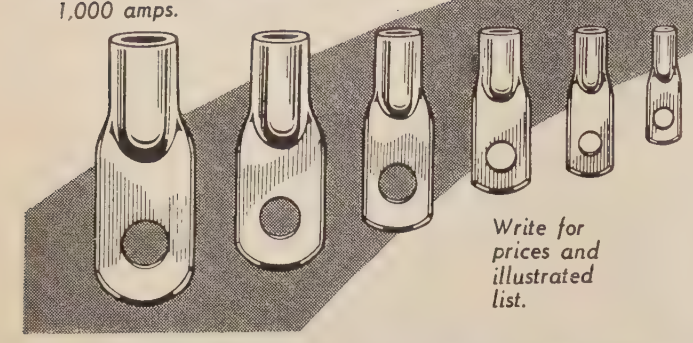
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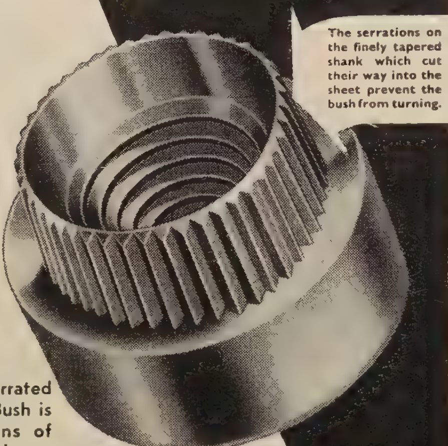

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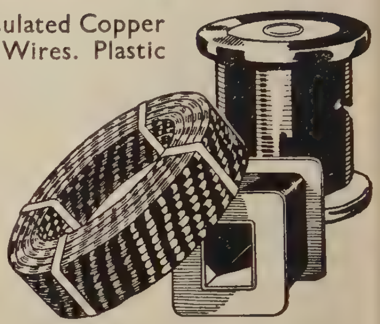

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Please address correspondence to **Editor, Advertisement Manager, or Publisher,** as appropriate. Published weekly (Fridays). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Price: 1s 6d per copy. Annual Subscription: Home £4 0s 0d; Overseas £5 15s 0d; U.S.A. and Canada $16.00. Remittances payable to " Electrical Review."

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# Reactive Load Compensation

THE initial stages are now being carried out of a major development in high power transmission in the United Kingdom. This work is aimed at reducing or eliminating the amount of reactive current which has to be carried by high voltage transmission lines to meet that part of the load. It will have the effect of both increasing the effective carrying capacity of the lines and of removing the need for the generators to meet the MVAr demand, which will of course enable the MW rating to be increased for a given frame size, a most important consideration today when transport difficulties are limiting individual unit sizes. Most reactive demand is produced by the load, the grid lines and transformers having a very small effect only.

Power factor correction at the load itself is, of course, a well-established technique, but no legislation exists to make the installation of power factor improvement equipment obligatory. Consequently, consideration is being given to effecting an improvement at major high voltage substations by inserting large shunt capacitors, now officially described as " compensators " when used in this application. A similar technique is employed in some overseas countries, but in these installations the capacitors are usually series connected. Thus the load supplied by the substation is not affected, the compensators merely serving to reduce the MVAr import.

Two types of compensator are available: banks of static capacitors or synchronous rotating condensers. The reactive power supplied by a synchronous machine can be varied immediately and steplessly simply by varying its excitation, whereas a capacitor installation lacks this advantage; the reactive power can only be increased by switching in additional banks of capacitors. Static equipment, however, costs only about one third of the price of a synchronous plant of the same reactive power. This is partly due to the fact that the foundations for capacitors, and their erection, are relatively simple. Moreover, maintenance and supervision are considerably reduced by the absence of moving parts and the complications of starting arrangements are avoided. A capacitor bank can be connected directly to the 132 kV system, whereas for a synchronous condenser an additional winding is necessary on the 275/132 kV auto-transformer to provide a 13 kV supply.

Another factor influencing the choice, particularly at the present stage of development and investigation, is that devices for controlling VAr flow should be transportable. This is because, to be fully effective, they must be situated at the most convenient point in the system, and as the demands are always changing at individual points on the system, so must the compensators be moved. A capacitor bank consists of many small, interchangeable units connected in series and parallel and these can be easily transported and reconnected for operation at any voltage on another site. Obviously, it would be desirable to combine the advantages of static plant with the synchronous machine's facility of stepless control. One possible development being considered to achieve this is the use of transductors to control a capacitor bank.

A considerable programme to investigate the possibilities of such schemes has been embarked upon by the C.E.G.B. A 40 MVAr static plant described on page 991 of this issue has been tested and commissioned at Fleet substation and 20 MVAr banks will shortly be put into service at West Weybridge and Elstree. In addition to these, a 40 MVAr synchronous installation is being commissioned at Iver and the static plant at Fleet is to be augmented by two 60 MVAr synchronous machines by 1963. Much will undoubtedly be learned from the operation of this plant, which will considerably ease the problem of supplying London's peak demand for the next couple of years, and extension of its use seems most likely.

## RESEARCH PRIORITIES

The latest survey, undertaken by the F.B.I., of the effort in money and manpower which British industry devotes to research and development raises more questions than it answers. This is largely because for the first time an important aim has been to obtain a qualitative picture as well as a quantitative one. At one extreme nearly half the firms replying to the questionnaire stated that they had no qualified men on research and development and at the other large firms in the " researching " industries (which includes the electrical industry) were dissatisfied with the extent of research in their own industries, their plans for extending their research facilities being held up by the shortage of qualified engineers and scientists.

Although it is encouraging to learn that the electrical industry spends proportionally more than the average on research on new products, the high level of its internal spending on basic research suggests that effort may here be wastefully employed. Private manufacturing industry spends on basic research over half as much as do the universities; the proportion spent on basic research to the total in American industry was only half that recorded in this country.

Unfortunately, the survey confirmed the rarity of well-established and sound procedures for choosing and reviewing research and development projects. Yet the fact that examples can be quoted of firms that have found satisfactory working solutions to the problem of selecting projects and measuring the return on research expenditure indicates that this is a direction in which further careful study would be rewarding. Certainly in conditions of growing world competition it is increasingly important that our resources should be efficiently used and qualified engineers and scientists are not the least important of these.

We extend to all our readers our
Best Wishes for Christmas
and the Coming Year

## RAILWAY TRACTION EXPERIENCE

The review by the deputy chief mechanical engineer of British Railways, Mr. E. S. Cox, on British Railways' experiences with diesel and electric traction (see last week's issue, page 964) contains many interesting observations on practical results up to the beginning of this year. On diesel locomotives, he says that no clear superiority had yet been established by either the electrical or hydraulic transmission systems, although the latter has a slight weight advantage. Three English firms are working on designs for new 2,700 h.p. units with electrical transmission and a fourth design with hydraulic transmission is going into production. All are competitive in cost and weight.

Operational results suggest that future designs of electric locomotives will incorporate high voltage control, semiconductor rectifiers, motors with two-part brushes, and improved equipment and cabling layouts. Apart from two series of major faults multiple-unit stock has operated well. New stock is likely to have semiconductor rectifiers only, largely because they do not require auxiliary circuits. Since a new series of multiple-unit sets with a maximum speed of 100 m.p.h. is now being designed for the London-Clacton service, it may be that these high performance units will be so equipped.

## A NEW BASIS NEEDED

At a time when many engineering concerns are reporting deteriorated conditions and expecting no immediate improvement a claim for higher wages from the employees in the engineering industry was hardly likely to succeed, especially when coupled with a demand for a shorter week—40 hours instead of 42.

The representatives of the Confederation of Shipbuilding & Engineering Unions did not react at all violently to the rejection of their claims by the Engineering Employers' Federation. The Federation's director, Mr. B. Macarty, contended that the concession of the claims would not be in the men's best interests as the result would be to increase production costs and thus further handicap the industry's endeavours to compete successfully in overseas markets. He said that the increases demanded were not justified by a rise in the cost of living. Mr. Macarty also referred to the criticism of the present " anachronistic wage structure " and suggested that if the unions had given the matter as much thought as the employers had a solution might have been reached by now. Both sides should get down to working out a realistic basis.

# TRANSMISSION CABLE PROTECTION

By G. S. WILTON
B.Sc., A.M.I.E.E.*

Underground high-voltage transmission cables are expensive and can be damaged easily by road works and other excavations carried out by those who are unfamiliar with these cables or, as can happen, unaware of their presence. The author describes the efforts of the South of Scotland Electricity Board to avoid these difficulties

With ever-increasing load, the problem of transmitting the power required to meet it, from generating stations to load centres in cities, becomes more difficult. In the case of the South of Scotland Electricity Board, this is well illustrated by the two maps of Glasgow. The first (below) shows the position at the inception of the 132 kV grid in South Scotland when no 132 kV underground cable was in use. That on page 988 shows the system as it will be in the near future, with a 275 kV grid line encircling the city and feeding distribution points in the centre; it also shows the 132 kV cable network which was laid as the grid system expanded.

Most readers will know that there are four main types of transmission cables, these being lead-sheathed (a) oil-filled, (b) gas-filled; and pipeline (a) gas compression (used in this country) and (b) oil static (used in the U.S.A. and France). The pipeline cables are encased in steel tubes about $\frac{3}{16}$in thick which cannot be pierced by prodding with a steel bar and are really difficult to puncture when a pneumatic drill is used. Even so, such pipes require careful attention under present-day conditions. For example, there is the necessity of protection from corrosion. Most types of mechanical protection, however, can be damaged on occasions by work in the road adjacent to the cables. Cases have been reported of 36in diameter metal pipes being dropped on the Board's 132 kV pipeline cables, naturally damaging a considerable amount of the protective serving on the pipe, although not damaging the cable inside. Where road alterations are required, special concrete protection may have to be placed around the pipeline to protect it from vibration transmitted from traffic.

In 1953, a four-mile double-circuit oil-filled 132 kV underground cable was installed through some of the busy main streets in the west of Edinburgh. Shortly after commissioning the circuit, it was found that a street excavation had taken place alongside the cable to permit the installation of a new gulley connection under the feeder. Local contractors working for individual property owners also made emergency openings for gas and water repairs and backfilled without notifying the Board. While no actual damage resulted from these excavations, the sand bed in which the cable was laid must have been disturbed and stones could have been put back pressing against the lead sheath of the cable.

The Board met representatives of the City Engineer's Department in an endeavour to control this situation. The city engineer asked that the route of our underground cables be marked in a special way, and it was agreed that the marking would be in the form of discs to be clamped to the lamp posts. Special concrete markers were also agreed for routes where lighting standards were not available.

In 1958, a 132 kV double-circuit oil-filled cable from a Glasgow generating station to a grid line termination tripped on severe fault. The cause of the fault was found

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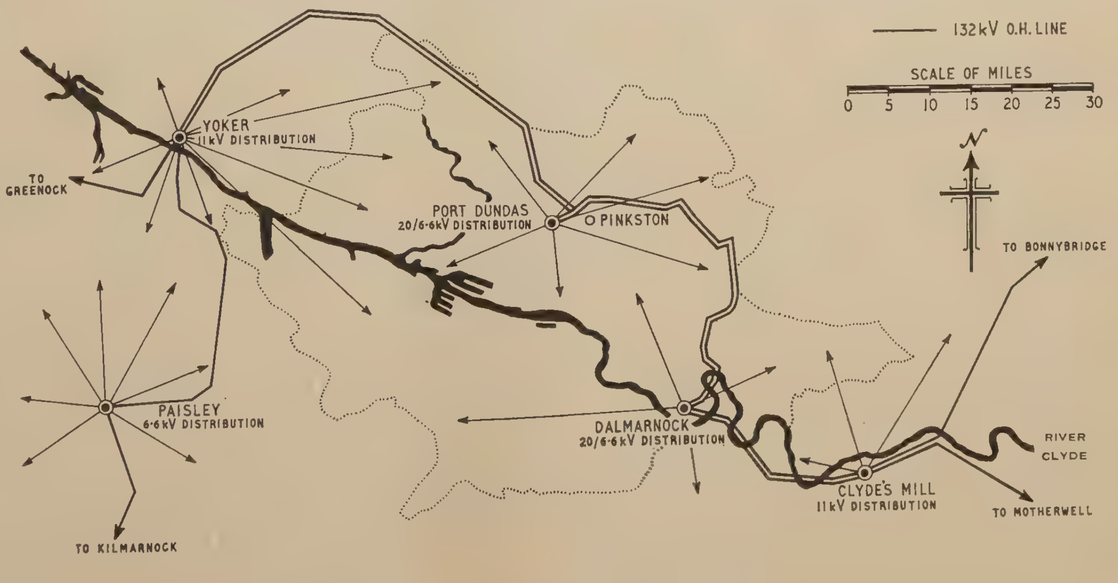
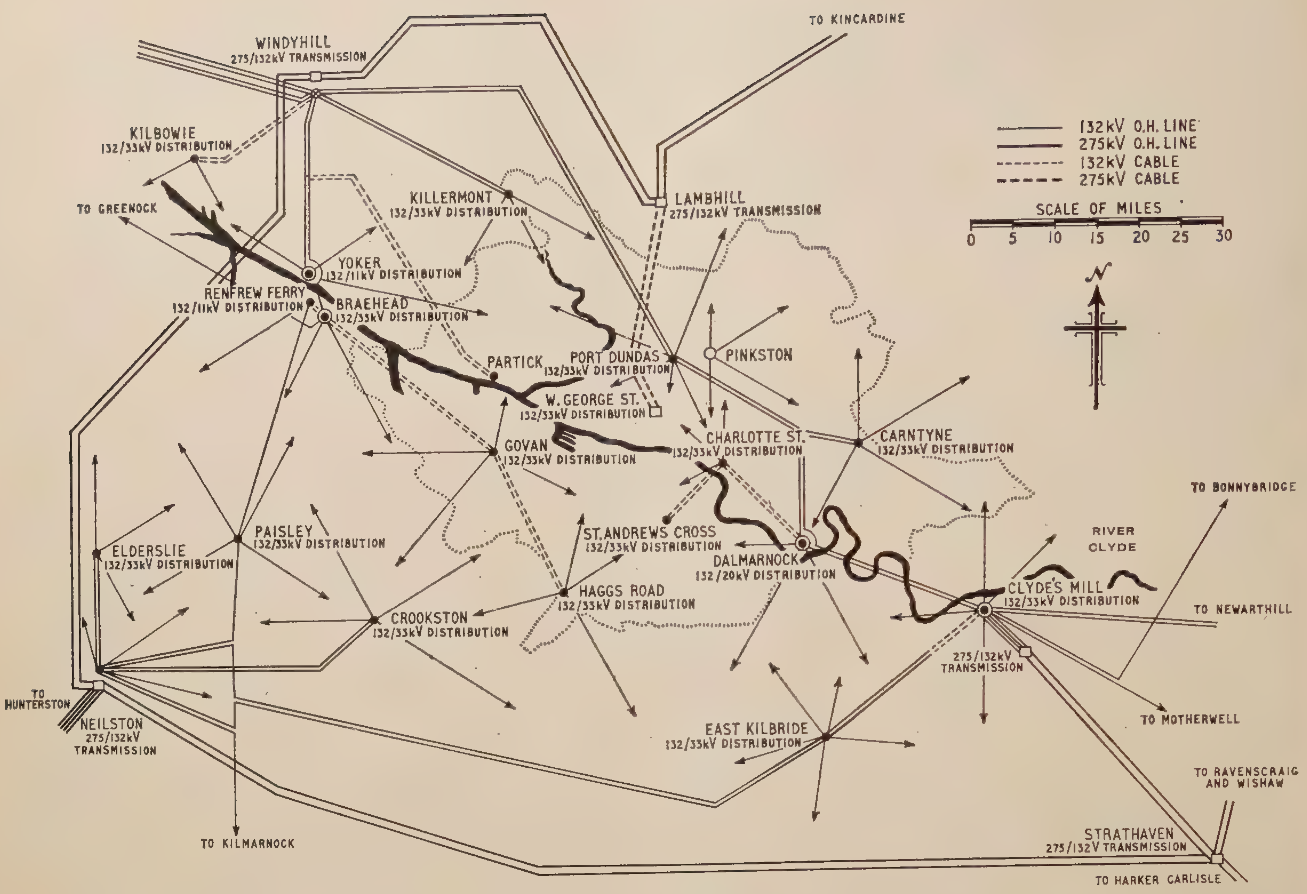
* Transmission/Distribution Engineer, South of Scotland Electricity Board.

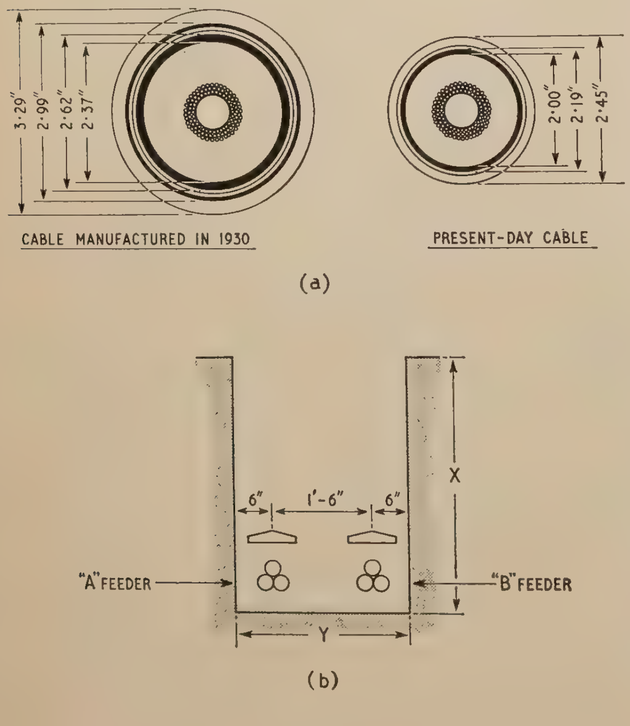


*The Glasgow area 132 kV transmission system in 1930. No underground cables used*



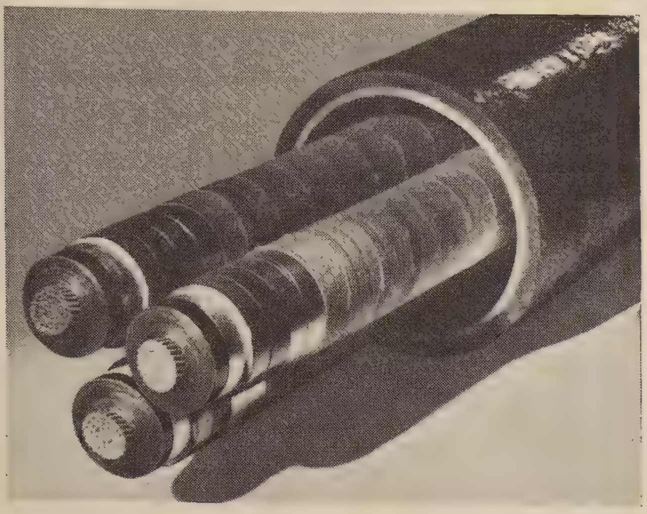
*The Glasgow area 275 kV and 132 kV transmission system in 1961. Underground cables used extensively in built-up areas*

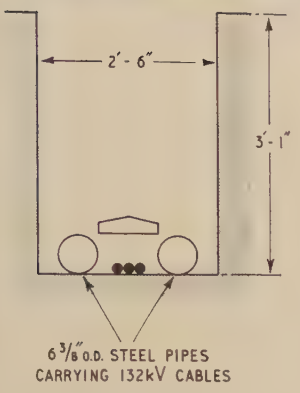
to be local authority staff looking for a water main by prodding the ground with a steel bar. One cable circuit had been holed and the man was prodding the second when the first cable developed a fault. Fortunately, the man was uninjured, but the damage to the cable cost £1,520 to repair. The repair was hardly complete when further damage due to excavation under the cables near the generating station end was discovered. This second repair had just been completed when, through low oil pressure indications, it was found that there was a third fault. This, on being located, was found to be due to damage following the erection of a lamp standard between the two circuits. The road boundary at this point had been altered some time previously and this necessitated an alteration in the position of some public lighting standards. The Board had not been notified of the alteration, so it was not possible to warn the lighting authority. In this particular case, a hole-boring machine had been used and during its operations brought up pieces of lead, copper tape and oil, all of which had apparently no significance to the machine operator. The cost of repairs on this job was £1,938, and was charged to the same authority as the first fault.



*(a) Comparison of 1930 single-core 132 kV oil-filled cable with similar cable of present-day manufacture. (b) Oil-filled cable shown in the ground. A protection slab is required over the cable*

Such repeated faults and costly repairs made the Board consider what steps could be taken to avoid recurrence. At a meeting with officials of the local authority concerned they agreed that cable markers, similar to those previously used in Edinburgh, would help them and they also asked for further sets of maps showing the cable routes, for display in their road foremen's offices. A further request was made for lists of the roads in which there were grid cables. It was obvious at the meeting that there had been confusion in the minds of those dealing





*Above: Enfield-Standard 132 kV pipeline compression cable. Left: The same cable shown in the ground. A protection slab is not required for steel pipe*

with road openings with regard to high-voltage cables for distribution and the 132 kV transmission cables. This point has now been satisfactorily cleared in the case of that particular authority.

In December, 1960, a meeting was held of the various local authorities in the Greater Glasgow area, water departments, public works departments, the G.P.O. and the Gas Board all being represented. When the cost of transmission cable repairs was explained, all parties were definitely interested in methods of avoiding such damage and agreed that the Board should indicate the routes of cables with lamp post markers and supply cable route maps and street lists.

At about the same time as the above meeting, there was another meeting, in this case at the request of the Scottish Building Trades Employers' Federation. Here again, the indicating of transmission cable routes by markers on the lamp posts was acceptable and cable route maps with a list of streets were asked for. The Federation agreed to advise its members in avoiding work which could be highly dangerous when carried out in the proximity of transmission cables.

As the South of Scotland Electricity Board covers generation, transmission and distribution, steps were taken to ensure that certain other departments of the Board were supplied with transmission cable route maps and other relevant information. This makes sure that where statutory road opening notices are sent to one department of the Board, the interests of the other sections are not forgotten. In generating station yards, etc., protection for cable routes may be best provided by fencing off the track. This is necessary today in large stations where earth-moving appliances operate. Routine patrols inspect the cable routes and report any sign of road openings, etc., because, in spite of all precautions, work may take place without prior notification. Where cables pass through private property special warning notices are erected, so that there is no possibility of the occupier being unaware of the presence of the apparatus, say through change of occupier or staff.

### Maintenance

As Scotland is remote from cable manufacturers who make the types of cable used in transmission, special arrangements have to be made with these firms with regard to maintenance and repairs, particular attention being given to stocks of spares, etc., since transmission cables are much less standardised than, say, 33 kV solid type cable.

Experience shows that remote electrical alarms indicating low gas or oil pressure to a manned point are absolutely essential, and in addition a regular weekly patrol of transmission cable routes is necessary. It is desirable, too, that periodic checks—say every three years or so—should be made with the local authorities and other organisations who in the course of their work make road openings, that the system of notices under the Public Utilities Street Works Act is functioning fully to all sections of the Board concerned. And, finally, the supply of cable route maps, street lists and the erection of cable markers by the Board must be kept up to date.

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# ACCEPTANCE TEST MEASUREMENTS

THE British Standard Specification B.S. 3435, "Methods for the Measurement of Electrical Power and Energy in Acceptance Testing" is intended to establish a common basis for the electrical measurements necessary when acceptance testing large electrical generators or prime movers. These tests on such machines, the output of which may be conveniently measured via the medium of electric generators, generally prove costly to arrange and to perform and it is hoped that the standard will assist in unifying procedures and reducing costs. The new specification extends beyond the existing standards for electrical instruments and meters, and lays down methods for their use during acceptance tests.

The standard relates to measurement of electrical equipment of 10 MVA and above, whether operating on d.c., or on a.c. at any constant frequency between 25 c/s and 100 c/s. According to the overall precision required during the tests, the standard allows for three different classes of overall accuracy of measurement, any one of which may be used for a basis for agreement on the measurement to be made. Account is taken of instrument errors during the tests and an appendix gives mathematical proof of the formulæ that are used.

Copies may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 8s 6d each.

# Satellite Instrumentation

Author's summary of a lecture given before a meeting of the Electronics and Communications Section of the Institution of Electrical Engineers on 20th December by R. L. F. Boyd, Ph.D., B.Sc.(Eng.), M.I.E.E.

THE exploration of space today is being carried out not by manned vehicles, though these may indeed be the forerunners of expeditions of discovery, but by scientific instruments. These instruments which depend, more than upon anything else, on electronics, must operate (often) for many months in an environment very different from the laboratory. They must maintain their calibration and must respond to an internal or radio-command programme on an extremely meagre ration of power.

Besides the basic instrumentation such as telemetry, tape recorders, power supplies and aspect sensors, a wide variety of equipment has been flown, from the simple Geiger counters of Explorer I to the complex television or facsimile systems of the Tiros meteorological satellites or the Lunik III moon probe. This lecture is concerned primarily with the kind of equipment that can be put in a relatively small satellite such as those launched by the Scout or Delta boost. This country is currently engaged in instrumenting a series of such vehicles, and it is this kind of system which is most likely to be first used by a European organisation.

## Design Problems

The main environmental constraint upon the design of satellite instrumentation arises from the absence of a significant gravitation-acceleration field, the very low pressure ($10^{-12}$ mm Hg), irradiation by intense ultraviolet and X-radiation from the sun and by fast particles and micro-meteoric dust. These factors introduce problems in connection with liquids, bearings, exposed surfaces and semiconductor devices.

The cost of launching scientific instruments is around £50,000 per lb so that space, weight and therefore power are inevitably in short supply. A typical satellite might weigh 150 lb, consume 5 W in all, of which 3 W would be used in the data recovery system and perhaps six experiments would use an average of $\frac{1}{3}$ W each.

Mechanical problems are particularly severe if parts must be free to move for long periods, otherwise the problem is largely one of obtaining an adequate strength-to-weight ratio, while as far as possible preventing resonance amplification of vibration during launch. Light alloy structures milled from solid are commonly used. Shells may be of fibre glass where eddy current damping of spin is to be avoided.

Current practice commonly makes use of solar cells for power supplies, though attention is being given to nuclear sources. In an unstabilised near-earth satellite, about 1·6 sq ft of cells per watt of mean power is required. Mercury or silver cells are used as primary sources and nickel-cadmium cells as secondaries in conjunction with the solar cells. Much use is made of transistor power convertors.

Thermal design of a satellite, to maintain it in the required temperature range under changing orbit conditions, is a factor requiring very careful attention. Some use has been made of dynamic systems, but passive control by the adoption of suitable absorptivity-emissivity properties for the surface is much more usual.

When ionospheric probing electrodes are used, it may also be necessary to control the potential of the vehicle. This is a complex problem which bears on the choice of surface and the geometrical configuration of the satellite. Another factor receiving more and more attention is the control of aspect, though to date measurement of aspect together with some degree of spin stabilisation has been more general.

In the past, use has been made of a variety of telemetry systems, but there is now a tendency to use either a digital one in which the sub-carrier carries binary pulses or a frequency-modulated sub-carrier. In both cases, the carrier is phase modulated and data are time multiplexed. Even a network of 15 telemetry receiving stations provides only very partial coverage of the telemetry transmissions so that increasing use is being made of tape recorders and other data storage systems in the vehicle.

The experience of those who have flown successful instrumentation has shown that it is hardly possible to give too much attention to the form in which the data are obtained and to the procedures envisaged for analysing them. A successful experiment can administer a knock-out blow to the group that devised it when it comes to digesting perhaps 12 months of data.

The testing of satellite instrumentation frequently involves as much work as development of the equipment. Temperature and vacuum cycling, vibration and acceleration must all be applied to individual equipments and to the whole payload. Only when all the equipment has shown itself capable of operating in prototype form, under tests exceeding actuality in severity and when the flight model has successfully weathered a laboratory simulation of the expected environment, can the satellite be mounted above its multi-stage rocket for boosting into orbit.

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## *Intercontinental Communications*

A STUDY group of the Conference of European Postal and Telecommunication Administrations has just ended a three-day meeting in London. This was held to consider various problems that might arise in the field of telecommunications by artificial earth satellites and was attended by representatives from 12 European countries.

Among the points discussed were the possible requirements for intercontinental telecommunication facilities via satellites, and the frequency space requirements to which these might give rise. The study group also briefly reviewed the progress being made in the construction of ground radio stations in Europe for participation in experimental tests with American communication satellites above its multi-stage rocket for boosting into orbit.

# Large Capacitor Installation

## POWER FACTOR IMPROVEMENT AT FLEET SUBSTATION

POWER imported into the London area over the 275 kV supergrid system is transmitted to major substations at a radius of some 20 miles from the centre. The supply is transformed to 132 kV and the power is fed at this voltage by overhead lines, and in central districts by cable, to 132/33 kV substations in the central area. As a temporary measure to assist in meeting London's peak demand over the next two winters it was decided to install shunt capacitors at three substations since, by providing leading reactive power, these installations enable the lines to handle a greater quantity of active power. The largest of these installations and the first to be commissioned is at Fleet substation. The capacitor battery is the first in the country to be connected to the 132 kV system and is rated at 41·7 MVAr. Future plans for this substation include the installation of synchronous condensers which are already being made, but the increase in peak demand last winter showed that a temporary measure would be advisable to safeguard power supplies until the commissioning date of the synchronous condensers. A feature of the installation was the very rapid manufacture and erection. Design work was not commenced until the end of March, 1961; nevertheless, the installation was completed and energised on schedule.

The capacitors are carried on vertical steel columns on steel platforms by standard insulators. The steel platforms are supported from the concrete foundations by one-, two, three- or four-unit standard insulators. A saving has been achieved by grading the insulation between the phase connections and the neutral point, but the battery can be easily modified to have full insulation if this should later be considered advisable.

The 81 $\mu$F capacitor units are rated at 1,190 V, 36 kVAr. Each phase consists of two parallel paths between the phase connection and the neutral point; each parallel path is made up of capacitor units connected three in parallel and 64 in series. The individual units have a single insulated terminal with the container used as the other terminal. This design enables one set of foils to be in metallic contact with the container, thus giving extremely good cooling. Highly purified and degasified mineral oil is used as the impregnant and is permanently maintained under a pressure of 2 or 3 atmospheres gauge by the flexible walls of the hermetically-sealed casing. This pressure serves to prolong the life of the capacitor considerably and also increases the dielectric strength and the " ionisation " or discharge inception voltage. That foil electrode which is not in contact with the casing is split up into 21 sections isolated from each other; each section is connected to the bushing via a fuse.

### Protective Gear

Each phase is separately protected by a compensated balance protection circuit designed to detect fuse failure. The compensating arrangement allows sensitive relay settings to be used, and also makes it unnecessary to " trim " the various portions of the battery to exact values to counteract manufacturing tolerances on individual units. Slight out of balance causes an alarm signal and more severe out of balance creates a tripping impulse to the breakers on each side of the 120 MVA, 275/132 kV auto-transformer, to the secondary side of which the battery is connected. In addition, a thermal over-current relay with a time constant of about 40 min and compensated for harmonics, is connected to each phase to initiate an alarm only. Finally, since the capacitor is not fed through a separate circuit-breaker, the battery is included in the transformer protective zone with which it is associated. The current transformers for over-current protection, for out-of-balance protection compensation and for balanced earth fault protection are connected at the earthy end of the capacitor battery; accordingly, it is possible to use current transformers with 11 kV insulation. The current transformers for out-of-balance protection are connected

*Two views of the capacitor bank at Fleet substation, showing, left, the graded insulation between the phase connection and the neutral point and, right, the mid-point current transformers for out-of-balance protection* at the mid-point on each phase, i.e. at a potential of 38 kV above earth. The installation has not necessitated the use of any additional 132 kV current transformers.

When switched off, the capacitor bank normally discharges itself through the power transformer with which it is associated. The phase terminals can then be earthed by earthing blades on the capacitor isolator. As an additional safety precaution for use during maintenance, the capacitor installation is fitted with equipment which permits, first, each of the 12 steel platforms to be earthed simultaneously in one operation and, secondly, each set of sixteen columns carrying capacitors to be easily and rapidly earthed in a single operation by a master handle.

The capacitors and the majority of the equipment were manufactured by ASEA, of Sweden, and supplied through Fuller Electric, Ltd., who acted as main contractors and who undertook erection work. The supporting insulators were manufactured by Steatite & Porcelain Products, Ltd. Equipment for earthing the capacitors for maintenance purposes has been supplied and erected by Power Connectors, Ltd. The installation was to the requirements of the chief transmission project engineer of the C.E.G.B. in conjunction with the consulting engineers, Kennedy & Donkin. (Editorial comment is made on page 985.)

# NEW BOOKS

**Nuclear Power Today and Tomorrow.** By Kenneth Jay. Pp. 270; figs. Methuen & Co., Ltd., 36, Essex Street, Strand, London, W.C.2. Price 25s.

Books on nuclear power for the non-specialist can be divided into two classes. Some deal mainly with fundamentals and describe power-producing reactor systems in general terms, while the other class is more concerned with the engineering of reactor systems with only a brief explanation of the basic processes. The second group soon become outdated and, unfortunately, the present book falls into this class.

In common with most other books of this type, basic theory is inadequately explained; perhaps it would have been better to have left it out altogether and concentrated on the main aim of the book which is to describe current developments in power reactors. Apart from the excellent descriptions of nuclear engineering details of all types of reactors from magnox to fast breeder systems and including various water-moderated types, the economics of nuclear power is lucidly explained. A chapter on other civil applications of nuclear energy covers marine propulsion, small power stations, process heat and industrial uses of irradiation. There are three appendices, a reading list, a glossary of terms and a table giving the leading characteristics of British power reactors.—T.C.

**An Introduction to Linear Network Analysis.** By P. S. Farago, Dr.Phil., F.Inst.P. Pp. 325; figs. English Universities Press, Ltd., 102, Newgate Street, London, E.C.1. Price 30s.

In its class, this is an exceedingly good book. It is not easy nowadays to write a really attractive book on network analysis that will command immediate approval, simply because there exists already a considerable number of excellent works on the subject at varying levels of presentation—introductory, intermediate, and advanced. That the present author has successfully surmounted the hazards thus pertaining to the subject is abundantly clear. The selection of material, the manner and easy style of presentation, the supporting illustrations, and the not-too-difficult mathematics all serve to emphasise the care which has been given to the preparation of this work, having in mind the competition.

The book is intended for honours students reading light current electrical engineering and for those post-graduate physics students who are interested in electronics and h.f. techniques. Notwithstanding this, there is much in it that will attract students of heavy current electrical engineering and they should certainly make a point of at least seeing the book. The first chapter is on d.c. networks and it gives an account of the usual laws, theorems, transformations, and fundamental theory connected with such structures. Chapter two deals with transient phenomena in various combinations of R, L, C circuits with pulse generator excitation. The behaviour of a.c. networks of wide variety and with lumped parameters is studied in chapter three, leading to the analysis of four-, six- and eight-terminal networks. Chapter four relates to transmission lines in which the parameters are distributed, impedance concepts and waveguides receiving particular attention. Thermionic valves as linear circuit elements are discussed in chapter five, which, amongst other things, covers diodes, triodes, the tetrode and pentode, amplifiers, oscillators, and feedback. An appendix gives the basic mathematics of complex numbers, matrices, characteristic impedance of transmission lines, field theory and network theory, and the general properties of guided waves.

A selection of problems (without answers) is given at the end of the book and there is a brief list of books for further reading. The mathematics is that of ordinary network theory supplemented by interesting applications of matrices. The book is well printed and produced and the combination of an excellent text and a modest price should produce an encouraging demand.—A.E.

## BOOKS RECEIVED

**Basic Principles of Electronics and Telecommunications.** By M. D. Armitage. Pp. 374; figs. George G. Harrap & Co., Ltd., 182, High Holborn, London, W.C.1. Price 22s 6d.

**Electrical Engineering Materials.** By A. J. Dekker. Pp. 208; figs. Prentice-Hall International, Inc., 34-36, Beech Street, London, E.C.1. Price 42s.

**Electric Lighting.** 2nd Edition. By C. E. Gimson. Pp. 224; figs. Cleaver-Hume Press, Ltd., 31, Wright's Lane, Kensington, London, W.8. Price 15s.

**Thermionic Valve Circuits.** By Emrys Williams. Pp. 427; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 27s 6d.

**Armature and Field Coils.** By Karl Wilkinson. Pp. 223; figs. E. & F. N. Spon, Ltd., 22, Henrietta Street, Strand, W.C.2. Price 35s.

**Hydraulic Extrusion Presses.** By Ernst Muller. Pp. 257; figs. Springer-Verlag, Heidelberger Patz 3, Berlin-Wilmersdorf. Price DM.39·60.

# Hunterston Nuclear Generating Station

By J. HENDERSON, B.Sc., M.I.E.E.,* G. F. KENNEDY, M.A., M.I.C.E., M.I.Mech.E., M.I.E.E.† and K. J. WOOTTON, B.Sc., D.I.C., Ph.D.‡

Summary by the authors of a paper entitled "Electrical Aspects of Hunterston Nuclear Generating Station," which was presented at a London meeting of the Supply Section of the Institution of Electrical Engineers in conjunction with the British Nuclear Energy Conference on 13th December

LIKE its nuclear contemporaries, Hunterston nuclear generating station will have operating characteristics which differ significantly from those of a conventional power station. Having a high capital cost but a lower fuel cost than a coal-fired station, it will be run at the highest possible load factor. There are, in addition, a number of technical reasons why it is preferable to run a gas-cooled Magnox reactor at a steady load. One of the most important of these is the need to minimise the thermal stresses induced in the structure and the fuel elements by rapid load changes. A large pumped-storage scheme under construction at Loch Awe, north of Glasgow, will assist in ensuring that an adequate base load is always available.

Nevertheless, it is undesirable that the station output should be totally insensitive to system frequency, especially as the Chapelcross nuclear station supplies an inflexible block supply to the same system. The station overall control scheme has therefore been designed so that the turbines unload in response to a large increase in system frequency, but at a very restricted rate. Small variations in demand within a certain dead band are not allowed to feed back to the reactor control system.

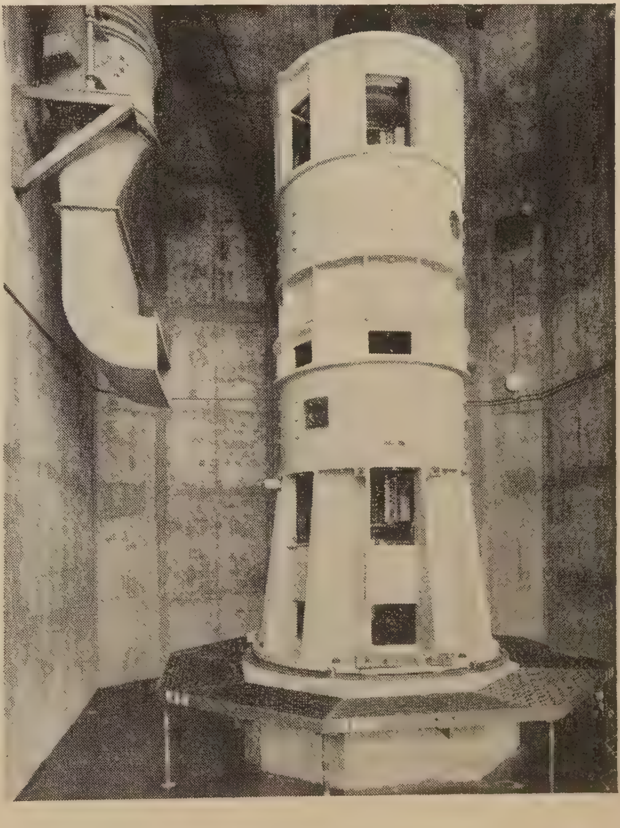
## Station Auxiliary System

The eight gas circulators per reactor are driven by large d.c. motors, and the total auxiliary load is 15 per cent of the station output—about three times as high as in a conventional station. In addition, the very special safety requirements of a nuclear station demand that no single fault, or reasonably probable combination of faults, shall lead to any risk of a reactor accident. Above all, the gas circulators must be kept turning at all times, even when the reactor is shut down. These considerations have led to an unusual design of auxiliary system.

There are three 60 MW generators associated with each of the two reactors, and as far as possible the heavy auxiliary load is supplied on a "unit" basis, i.e. directly from the generator terminals. If a unit transformer supply should fail, the load is transferred rapidly and automatically to a station board. This principle of "quick switching" has not been applied to a major power station in this country before, although it is fairly popular in the United States. Care is needed in the design to ensure smooth reacceleration of the dozens of motors which, of course, begin to run down as soon as the supply is interrupted.

The "essential supplies" system, which ensures that certain vital auxiliaries, including some gas circulators, are kept running even after all normal a.c. supplies have been lost, consists of heavy duty batteries which normally float in parallel with a rectified supply, backed up in the last resort by three diesel generators, any one of which is capable of carrying the whole essential supply load indefinitely.

There are, in addition, standby supplies, duplicate cable routes, and automatic protective devices on a generous



*G.E.C. gas circulators for Hunterston nuclear generating station* scale. Every effort has been made to ensure that, while the reactor must be shut down instantly should a dangerous fault develop, the sensitive trip system does not operate spuriously, causing an expensive loss of generating capacity.

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* South of Scotland Electricity Board.
† Kennedy & Donkin.
‡ General Electric Co., Ltd.

The choice of eight gas circuits per reactor and centrifugal blowers, which run at comparatively low speed, led to the selection of direct current motors for the drives. These machines are extremely easy to control, and it is possible to overspeed the circulators without a serious loss of efficiency, so that one circuit may be valved off for maintenance without sacrificing station output. Each motor can be trimmed separately, and there is no need for a separate pony motor, as the circulators may be run at reduced speed directly from the station batteries.

Normally, the 2,350 h.p. tandem-armature motors, one of which is illustrated here, are fed from mercury-arc rectifiers, and speed is adjusted by grid control of the d.c. output. The complex circuits required to ensure stability of the rectifiers at all times are discussed.

Direct current motors are sometimes criticised because of the need for brushes and commutators, and difficulties with these have been experienced on the Calder Hall drives. The Hunterston design has, however, been fully proved by practical testing on site over many months, and a means for changing brushes at full load has been developed. The drive is a vertical one, and it incorporates a heavy flywheel to increase the rundown time of the circulators following an interruption of the supply.

## DISCUSSION

Mr. H. H. Gott (C.E.G.B.), who opened the discussion on the paper, regretted that the authors had not devoted more attention to the principles which formed the basis for the design at Hunterston; for example the basis on which reactor control would be set up. Many alterations in outlook had occurred since the station was first conceived. He thought that these early nuclear stations had turned out to be very much more complicated and to have much more design content in them than had at first been foreseen. It was important to assess how much of this complication was justified. The observance of the principle of " failing safe " was essential, but very unlikely events could be postulated and the most that could be done was to consider very carefully the design of components and circuitry and then see whether the result was good enough for the duties to be met.

Mr. P. T. Fletcher (United Power Co.) said it could be inferred from the paper that the design of control systems had been influenced by changes in thinking in the course of design and manufacture. The authors spoke of operation at 80 per cent load factor, but a great deal more experience was needed in the operation of nuclear plant before there could be full confidence in operating in this way. Experience with Calder Hall and Chapelcross stations suggested that a 75 per cent load factor could be bettered. A closer relationship between the installation of pumped storage and nuclear schemes should be studied. There should be a 10 per cent saving in overall generating cost if the load factor could be lifted from 75 per cent to 85 per cent.

Mr. R. D. Trotter (C.E.G.B.) said that a major contribution to system stability would not be made unless the station was able to pick up extra load, which it could not do if normally running at the maximum power output. On the question of circulator drive he said that on a base load station the primary considerations were drive security and efficiency at full load; efficiency at part-load speeds came far behind in importance. Although d.c. motors offered a wide, efficient speed range they were not a prime example of a secure system.

Mr. D. A. Dewison (C.E.G.B.) called attention to the quick change-over technique introduced at Hunterston. This had not been used at any other station in this country, presumably because faults which caused a failure of the normal supply usually required unit shut-down; there was no point in keeping the generator running to feed into a fault. That applied also at Hunterston, and the use of this feature with its attendant relays and interlocks made the electrical system more complicated and introduced further hazards of maloperation.

Mr. G. P. Bugden expressed surprise that the quick-switch system adopted at Hunterston had been criticised on the grounds of complexity; in his experience the circuitry involved was not usually exceedingly complex unless an effort was made to restore the supply within a few cycles of the interruption. If a delay of a second or two could be tolerated, very simple and reliable means could be adopted to initiate the quick switch. The number of gas circulators which a reactor could afford to lose without forcing shutdown was a major factor in the design of the systems supplying the drive. The bus transfer scheme at Hunterston ensured that each circulator had in effect a 100 per cent back-up supply.

Mr. H. Heimer agreed with Mr. Bugden that the circuitry of the quick-switch system was not complex. It was hoped that it would take about 1 sec to reach the 25 per cent voltage after which the alternative supply was switched in. Tests had been made to see how long it took to slow down to 25 per cent and a considerable amount of work would be done during the commissioning of the scheme.

Mr. B. H. Stonehouse (G.E.C.) emphasised the complexity of the calculations which the designer had to undertake and the uncertainty of some of the answers, for example as to the amount of thermal cycling that the fuel elements would stand. This led to the requirement that the scheme should be made flexible, and it had also to be made highly reliable, but these requirements were in conflict. There had recently been a question of two possible systems of control. One had a large number of components, the complexity being due to making it fail safe. It had a probable total failure rate of once every 2,000 hours, but only once in 200 years would it fail unsafe. The second system was simpler and had a probable failure rate of once in 20,000 hours, but the failures would be divided about equally between safe and unsafe.

In reply to the discussion, Mr. G. F. Kennedy did not agree that provision for part-load performance was not justified for any power station which had to be run as part of a commercial enterprise. Generating stations must follow the load and it must be expected that a nuclear station connected to the grid would have to operate at part-load and to vary its load. It was no use saying that this was not possible; it had got to be done. Mr. K. J. Wootton said that there was a tendency to fit too much in nuclear stations and he hoped the time was coming when they could be simplified. On the use of d.c. motors for the blowers, he said that the motor could not be considered in isolation; it was necessary to consider the whole drive. They would not in the present state of knowledge drive blowers with d.c. motors because experience had demonstrated that it was an advantage to use more of the reactor power in blowing rather than less, and in increasing the power requirement for the blower to improve the efficiency of the whole cycle one got outside the range of a reasonable d.c. drive. Mr. J. Henderson emphasised that one of the main factors in pumped storage was that it must be cheap; the cost per kW must not be greater than that of a modern power station.

# Aluminium Winding Conductors

Developments in the insulation of aluminium winding conductors are described with particular reference to the choice of enamels. The use of glass fibre insulation is also discussed. This article has been translated from *Elektrichestvo* No. 4, 1961

By PROFESSOR DR. V. A. PRIVEZENTSEV

UNTIL recently, the use of enamelled aluminium winding conductors in the U.S.S.R. has been restricted to those spheres in which the low specific gravity of aluminium has substantial importance. At the present time, the rapid growth in the demand for winding conductors has led to the need for planning the mass production of aluminium winding conductors with various forms of insulation. This is also promoted by the appreciable reduction in the cost of aluminium wire.

If we compare aluminium and copper conductors of equivalent electrical conductivity, then the use of aluminium, disregarding the considerable concomitant technical difficulties, will become expedient if the following relationship exists between the costs of aluminium $P_{Al}$, and of copper, $P_{Cu}$,

$$P_{Al} \leq \eta P_{Cu},$$

where

$$\eta = \frac{\gamma_{Cu}\ \rho_{Cu}}{\gamma_{Al}\ \rho_{Al}};$$

where $\gamma_{Cu}$ and $\gamma_{Al}$ are the densities of copper and aluminium; and $\rho_{Cu}$ and $\rho_{Al}$ are their specific resistances.

In Fig. 1, the prices in the U.S.S.R. of uninsulated copper and aluminium wire are shown; it is easy to satisfy oneself that in principle the replacement of copper by aluminium wire produces a great economic saving. In reality, the value of $\eta$ is about equal to 2. At the same time, it is evident from Fig. 1 that at the present time aluminium wire of 1 mm diameter and above has become cheaper than copper wire of the same diameters.

The properties of aluminium, used in the Russian electrical industry, are generally known, and are therefore not given here. For the production of current-carrying cores of conductors and cables, metal with an aluminium content of not less than 99·5 per cent is used. In all Russian standards and technical specifications for this grade of aluminium the specific resistance should be not more than 0·0295 ohm/sq mm/m, both for hard and for annealed wire.

In other countries, higher demands are presented for aluminium in relation to electrical conductivity. In fact, in the German Federal Republic until recently the standards shown in Table I were in operation.[1] The specific resistance, just as with copper wire, is dependent on the diameter; for wires of small diameters it is somewhat higher than for those of larger diameters. According to data of the same author,[1] the values shown in Table II were obtained in practice for various dimensions of aluminium wire.

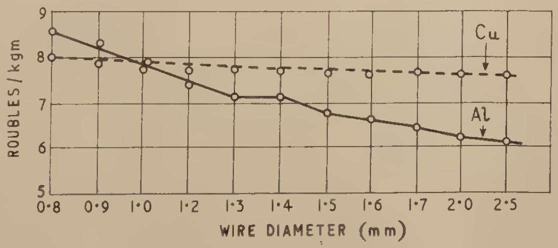

*Fig. 1.—Cost in Russia of uninsulated copper and aluminium wires of various diameters*

TABLE I.—ALUMINIUM CONDUCTIVITY STANDARDS IN THE GERMAN FEDERAL REPUBLIC

| Marking of Al Wire | Tensile Strength, kg/sq mm | Maximum Permissible Specific Resistance at 20°C, ohm/sq mm/m |
|---|---|---|
| E–AlF–7 | 7–9 | 0·02778 |
| E–AlF–9 | 9–13 | 0·02825 |
| E–AlF–13 | 13–17 | 0·02849 |
| E–AlF–17 | 17 and over | 0·02874 |

TABLE II.—SPECIFIC RESISTANCE OF ALUMINIUM WIRE

| Marking of Al Wire and State | Diameter, mm | Specific Resistance, ohm/sq mm/m |
|---|---|---|
| F–9 soft | 0·15–0·7 | 0·02825 |
| F–7 soft | 0·7–6·0 | 0·02778 |
| F–17 hard | 0·15–4·5 | 0·02874 |
| F–13 hard | 4·5–6·0 | 0·02849 |

Recently in the German Federal Republic the values for the specific resistance shown in Table III have been proposed as standards for aluminium wires of various diameters. The values shown in the table amount to about 95-96 per cent of the specific resistance of 0·0295 ohm/sq mm/m, which is specified in the U.S.S.R. It is therefore of great practical importance for Russia to carry out scientific research and experimental work on a reduction in the specific resistance of aluminium for conductors to about the values shown in Table III, since this ought to produce a considerable economic saving. Such a reduction could be attained primarily by means of appropriate control of the silicon content of the aluminium. In this connection great importance attaches to the relationship between the electrical conductivity of aluminium and its silicon content and iron content. This is shown in Fig. 2.[2]

Numerous measurements of the specific resistance of soft and hard aluminium wire of various diameters, used at the present time in Russian cable works, shows that this value varies within the limits of 0·0282-0·0286 ohm/sq mm/m.

A reduction, therefore, in the value of the standard for the specific resistance to 0·0285 ohm/sq mm/m is possible in the U.S.S.R. without considerable technical complications and without carrying out additional protracted research. For this purpose, it is necessary to go

TABLE III.—SPECIFIC RESISTANCE STANDARDS FOR ALUMINIUM WIRE IN THE GERMAN FEDERAL REPUBLIC

| State | Ultimate Tensile Strength kg/sq mm | Specific Resistance at 20° C, ohm/sq mm/m | |
|---|---|---|---|
| | | Maximum Permissible Value | Calculated Value |
| Annealed (soft) | <10 | 0·0280 | 0·0278 |
| As drawn (hard) | >15 | 0·028264 | 0·028264 |

TABLE IV.—THE USE OF RUSSIAN PLANT IN ENAMELLING BOTH COPPER AND ALUMINIUM WIRE

| Type of Enamelling Plant | Diameter of enamelled wire, mm | |
|---|---|---|
| | Copper | Aluminium |
| Horizontal type ET–8 | 0·04–0·09 | 0·085–0·20 |
| Vertical type M–24–58 | 0·09–0·19 | 0·15–0·35 |
| ,, S–24–58 | 0·19–0·41 | 0·38–0·67 |
| ,, B–30–A | 0·4–0·8 | 0·69–1·35 |
| ,, B–30–B | 0·1–1·2 | 1·40–2·44 |

thoroughly into the question of the method of selection and determination of the electrical resistance of aluminium wire. Possibly it will be expedient to carry out this determination on several small specimens and, as the final result, take the mean of the individual measurements, at the same time restricting the permissible limits of variation of the electrical resistance.

## Enamel Insulation

When replacing copper winding conductors by aluminium wires, account must be taken of the considerable increase in cross-section of the latter for equivalent electrical conductivity. Primarily, therefore, it is necessary to develop the production of conductors with a high-strength enamel insulation for their use in electrical machines, apparatus and instruments. At the present time such conductors of 0·57-2·44 mm diameter to comply with the TUKP 49-59 technical specifications are produced with enamel insulation of normal and greater thickness consisting of polyvinylacetate lacquers (Vinyflex and Metalvin) under marks PEVA-1 and PEVA-2 and of polyamidnorezol lacquer under marks PELRA-1 and PELRA-2.

The technical process of enamelling aluminium wire is considerably more complicated than that of enamelling copper, in view of its lower mechanical strength, and up to the present time not all the difficulties have been overcome in the U.S.S.R. In Russia, drawn aluminium wire is normally used for the enamelling of wire of 0·77 mm and under in diameter. Wire of 0·80-0·96 mm in diameter is used in connection with the existing technical equipment both in the hard and in the annealed condition, and wire of 1-2·44 mm in diameter is used only in the annealed form. The relative elongation of enamelled aluminium conductors in accordance with TUKP 49-59 for small cross-sections of up to 1 mm in diameter should be not less than 10 per cent, and within the limits of 11-15 per cent for heavier gauge wires.

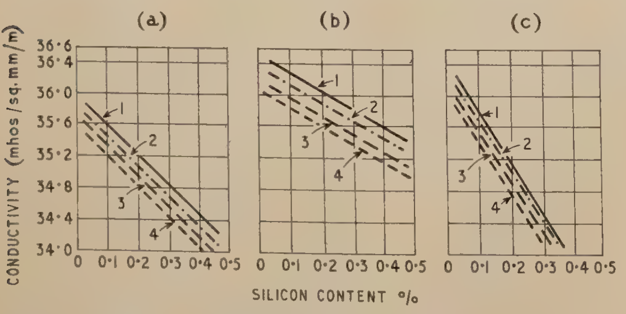

*Fig. 2.—Relationship between the electrical conductivity of aluminium and its silicon and iron contents. (a) 95 per cent cold working; (b) annealed for 4 hours at 350°C (in air); (c) annealed 2 hours at 500°C (without access of air); (1) 0·1 per cent Fe; (2) 0·2 per cent Fe; (3) 0·3 per cent Fe; (4) 0·4 per cent Fe*

The second special feature of the technique of enamelling aluminium wire is the somewhat lower temperature in the enamelling furnaces than for enamelling copper wire. This is partly explained by the fact that for heating to any given temperature considerably less heat is required for aluminium wire than for copper wire. In fact, for heating a unit length of wire up to any given fixed temperature the required quantity of heat can be expressed by the equation

$$Q = \alpha \gamma c,$$

where $\alpha$ is the coefficient of proportionality;

$\gamma$ is the density of the metal; and

c is its heat capacity.

The ratio of these values for copper and aluminium of one and the same diameter is

$$\eta = \frac{Q_{Cu}}{Q_{Al}} = \frac{\gamma_{Cu}\, c_{Cu}}{\gamma_{Al}\, c_{Al}} \approx 1{\cdot}57$$

Depending on the type of enamelling furnaces, the diameter of the aluminium wire being enamelled, and the rates of enamelling adopted, the temperature in the lower temperature zone of the furnace should be from about 220 to 250°C, ±20°C, and in the higher temperature zone of the stoves from 310 to 350°C (±20°C).

The enamelling of aluminium wire can be carried out in the same plants as are used for the enamelling of copper wire. In this event, measures should only be taken to facilitate the passage of the wire through the plant and to reduce its tension. This is particularly important for the enamelling of aluminium wire of 0·7 mm and under in diameter. For the mass production of aluminium wire of small diameters, it may possibly be expedient to provide special enamelling plants.

It is thus possible, in one and the same plant, to enamel aluminium wire of larger cross-sections than copper. We can readily satisfy ourselves of this from the approximate data shown in Table IV for basic technological equipment at cable works in the Soviet Union. The ranges indicated in this table are approximate, and may be changed somewhat with the development of the production of aluminium wire. On account of the difference in the specific gravities, the somewhat lower enamelling rates and the greater tendency to fracture of aluminium wire, the labour required for the production of 1 kg of aluminium enamelled wire is at present about 4·5-5 times greater than for copper wire.

The quality of the enamel insulation on aluminium conductors is close to the quality of the enamel on copper conductors, where the same resins are used. It should be noted that the behaviour of aluminium wire is more stable at high temperatures in comparison with copper, which relatively quickly becomes coated with a layer of copper oxide at temperatures over 225°C. Simultaneously at these temperatures its electrical resistivity noticeably starts to rise. The presence on aluminium wire of a layer of aluminium oxide, $Al_2O_3$, has a stabilising influence on the enamel insulation in comparison with copper wire, and therefore the heat resistance of enamelled aluminium conductors using the same lacquers is about 6-10°C higher than of copper conductors. This is confirmed by investigations of 1·2-1·5 mm diameter copper and aluminium enamelled conductors, manufactured with the use of polyurethane lacquers (Fig. 3). Similar results have been obtained also with the use of polyester lacquer No. 124-VEI (Fig. 4), and also during investigations of copper and aluminium conductors enamelled with polyvinylacetate lacquer, Vinyflex, and polyamidnoresol lacquer PL-2.

The mechanical strength of the enamel insulation on aluminium conductors is about the same as that on copper wires, but in the technical specifications already indicated, out of four tests at various points on a specimen of a conductor, taken from one coil, three ought to withstand not less than 30, and one not less than 20 reciprocating motions of a 0·6 mm diameter steel pin, which is somewhat below the requirements laid down in GOST 7262-54 for high-strength enamelled copper conductors. This is partly explained by the greater softness of aluminium wire in comparison with copper, which results in a greater depth of penetration of the needle of the test machine into the enamel insulation and somewhat more rapid abrasion.

## Paper and Fibre Insulation

At present, aluminium winding conductors with paper and glass fibre insulation (Marks APB, APBBO, APSD, etc.) are starting to find fairly wide application. Round Mark APB conductors are produced in accordance with the technical specifications of TUKP 32-58 from 1·62-5·2 mm in diameter with the same thickness of paper insulation as for copper, Mark PB conductors. Conductors of square cross-section, Mark APPBO, which are also governed by TUKP 32-58, are produced of the same cross-sections and with the same thicknesses of insulation as Mark PPBO copper conductors. These conductors are basically intended for transformer construction. A somewhat smaller quantity of Mark APBD conductor wire with paper insulation is produced, although in the Soviet Union such conductors are successfully used in considerable quantities for the manufacture of electric welding equipment.

Round Mark APBD conductors are chiefly manufactured from wire of 1·62-5·2 mm diameter, and square conductors in the same range and with the same thickness of insulation as square copper, Mark PBD conductors. Square aluminium conductors are prepared in accordance with the technical specifications of TUK OMM 505 209-56. At the present time, a suggestion is being worked out for a suitable standard for all the conductors enumerated.

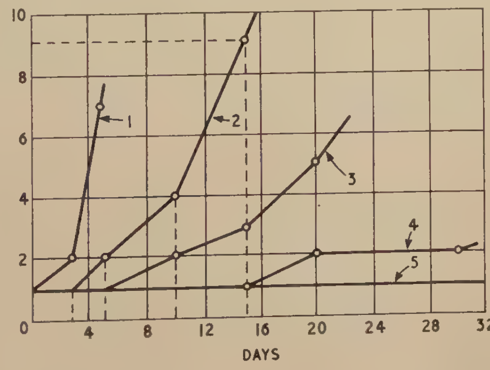

*Fig. 3.—Change in the elasticity of the insulation of copper and aluminium conductors, enamelled with polyuretha lacquer, in relation to the dwell time at elevated temperature: D diameter of cylinder on to which the conductor was wound for testing; d diameter of uninsulated wire; (1) copper wire at 180°C; (2) aluminium wire at 180°C; (3) copper wire at 150°C; (4) aluminium wire at 150°C; (5) copper + aluminium wire at 125°C*

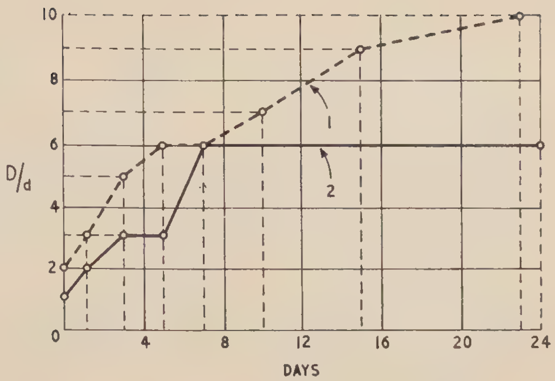

*Fig. 4.—Change in the elasticity of the insulation of copper and aluminium conductors, enamelled with lacquer No. 124, in relation to the dwell time at elevated temperature: D diameter of cylinder on to which the conductor was wound for testing; d diameter of uninsulated wire; (1) copper wire at 180°C; (2) aluminium wire at 200°C*

Winding conductors with glass fibre insulation are of importance. Round conductors with double glass fibre insulation, 1·62-5·5 mm in diameter, and square conductors of various cross-sections (Mark APSD) are produced in accordance with the technical specifications of TUKP 33-58, and are intended for the windings of electrical machines, plant, instruments, etc., working at temperatures of −60°C to +155°C. In practice, they can even operate at a somewhat higher temperature.

Investigations which have been carried out show that at temperatures of 300-400°C glass fibre insulation on aluminium conductors is more stable than on copper conductors. Thus, during an investigation of the change in the electrical and mechanical strength of glass fibre insulation in relation to the dwell time at 400°C, it was established that on aluminium conductors the elasticity of the insulation remains practically unchanged for a long time, while on copper conductors due to the catalytic action of the copper, the process of ageing of the glass fibre insulation and the fall in its elasticity occur at a very high rate. This also explains the necessity for the use of a protective sheath of a thin layer of aluminium on certain copper conductors intended for operation at temperatures exceeding 225°C. For operation at especially high temperatures of over 350°C, it is expedient to use trimetallic conductors, in which between the copper conductor and the aluminium sheath a thin barrier layer

TABLE V.—ACTIVE RESISTIVITY OF CONDUCTORS IN RELATION TO THE DWELL TIME AT A TEMPERATURE OF 300°C (PERCENTAGE OF INITIAL VALUE)

| Material of Conductor and Diameter | Time, hours | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 24 | 72 | 120 | 168 | 240 | 388 | 480 | 792 | 984 | 1272 | 1560 |
| Copper, 0·80 ... ... | 102 | 106 | 110 | 114 | 120 | 129 | 133 | 146 | 150 | 164 | 162 |
| Copper + aluminium, 0·49 | 100 | 100 | 101 | 103 | 105 | 107 | 108 | 110 | 113 | 113 | 114 |
| Copper + anodised aluminium, 0·49 ... ... | 100 | 100 | 100 | 102 | 103 | 103 | 104 | 106 | 106 | 107 | 107 |
| Copper + silver + aluminium, 0·80 ... ... | 100 | 101 | 101 | 103 | 104 | 104 | 104 | 107 | 107 | 108 | 108 |
| Copper + nickel + aluminium, 1·00 ... ... | 100 | 100 | 100 | 100 | 102 | 102 | 103 | 106 | 106 | 107 | 107 |
| Aluminium, 1·50 ... | Practically without change | | | | | | | | | | |
| Anodised aluminium, 1·00 | | | | | | | | | | | |
| Anodised aluminium, 0·65 | | | | | | | | | | | |
| Nickel, 0·50 ... ... | | | | | | | | | | | |

of nickel or of silver is additionally provided, preventing the mutual diffusion of particles of copper and aluminium into each other and a change in the properties of the conductor.

In Table V, data on the change in the electrical resistivity of various conductors in relation to their dwell time at a temperature of 300°C are given. From the table, it is evident that for aluminium/nickel wires, and also for aluminium conductors with oxide insulation, the resistivity remained unchanged for a very long time. Thus, as a heat-resistant insulation, great importance attaches to an oxide insulation on aluminium, about which some brief remarks are made below.

An oxide insulation on aluminium conductors is produced by the electrochemical method. It has been known for a long time.[3] In fact, at the " Moskabel " works in the Soviet Union production of anodised aluminium conductors was started in the year 1934. But in consequence of the lower mechanical and electrical insulation properties by comparison with enamel insulation, aluminium conductors with oxide insulation did not then find application.[4]

For special winding conductors required to operate at temperatures exceeding 200°C, interest in conductors with oxide insulation has once again increased. In fact, in France, Canada and England[5-9] specialised works have started to produce anodised aluminium wire. In 1959, at NIIKP, S. D. Kholodnyi, V. L. Gantts and others[10] formulated a production technique for conductors with a flexible oxide insulation. The formation of the oxide insulation ($Al_2O_3$) is possible by means of direct or alternating current, but much better results are given by the simultaneous use of direct and alternating currents (oxidation with " superimposed current ").

The oxide insulation has a porous structure (Fig. 5). The greater the degree of porosity of the film, the better is its flexibility. By an appropriate change in the technique of oxidation (by the addition of alkaline metal, etc., to the solution of sulphuric acid, for instance) it is possible to increase somewhat the flexibility of the oxide film and to reduce the time for its formation. As distinct from enamel insulation the oxide film has a very rigid structure, and is not subject to noticeable compression or elongation.

A certain increase in the flexibility is possible at the expense of a reduction in the electrical strength of the insulation and of a simultaneous considerable reduction in its mechanical strength in consequence of the increase in porosity; nevertheless the elasticity of oxide insulation remains considerably lower than that of enamel insulation. The electrical strength of oxide insulation, determined on two twisted specimens according to the method of GOST 7262-54, amounts to 250-350 V, i.e. falls considerably below the electrical strength of enamel insulation. But the great advantage of oxide insulation is that at temperatures of 200-500°C its electrical strength remains on a sufficiently high level, and in practice decreases very slightly.

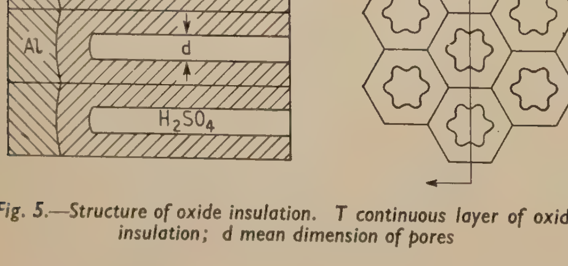

*Fig. 5.—Structure of oxide insulation. T continuous layer of oxide insulation; d mean dimension of pores*

Oxide insulation is extremely hygroscopic, but even after a dwell time of two hours at 85 per cent relative humidity the resistivity of the insulation of oxidised conductors totals 0·5 megohm/m. Impregnation of anodised conductors with heat-resisting silico-organic lacquers or suspensions based on fluoplastic-4 improves the electrical and mechanical characteristics, but at temperatures exceeding 300°C the impregnation gradually burns away or vaporises, and the resistance of the insulation during humidification approximates to the same values which the conductors have in the unimpregnated state.

Glass fibre insulation, deposited on to anodised aluminium conductors, behaves with considerably greater stability at high temperatures than on copper or even silver-plated copper wire. This is confirmed by an investigation of the change in the electrical and mechanical strength of the glass fibre insulation of the conductors indicated during dwell times of 24-500 hours at from 400 to 450°C, ±50°C. Thus, whereas on silver-plated copper conductors, a glass fibre sheath is completely destroyed after 200-240 hours' dwell time at 450°C, ±50°C, on anodised aluminium conductors, however, it still to a certain extent maintains its soundness after a dwell time of 300-360 hours at the same temperature, and withstands three double movements of the needle of the instrument for abrasion testing of the insulation.

Oxide-glass fibre insulation is, at present, one of the basic forms of electrical insulation of conductors, capable of withstanding a temperature of 400°C for the comparatively long time of not less than 400-500 hours in every instance and about 100 hours at 450-500°C. It can be shown that on the anodised aluminium surface, glass fibre insulation has greater stability than on ordinary aluminium conductors especially at temperatures of 400-450°C. It should also be held in view that the active resistivity of aluminium conductors and conductors with an anodised aluminium surface changes, as has been shown above, considerably more slowly as a result of the action of high temperatures than that of conductors with other forms of protection of copper against oxidation.

The comments and recommendations presented above, in relation to the use of winding conductors with high heat resistance, should be carefully verified by users of these conductors in relation to the practical conditions of their service in any given components.

## REFERENCES

[1] H. D. Feldmann, Properties and Production of Aluminium Wire, Aluminium, 1958, No. 9.

[2] E. Nachtigall, Electrical Conductivity of Aluminium, Aluminium, 1954, No. 12.

[3] B. M. Tareev, Oxide Insulation (Oksidnaya izolatsiya), Gosenergoizdat, 1934.

[4] V. A. Privezentsev, Conductors with Oxide-Enamel Insulation, Vestnik Elektropromyshlennosti, 1935, No. 7.

[5] P. Russell, "Filoxal" Conductors in Aluminium Insulated by Anodic Oxidation, Bull. SFE, 1958, No. 8.

[6] P. Smit, Anodized Aluminium Wire, Mod. Metals, 1958, No. 7, pp. 30, 32, 34.

[7] F. Keller, M. Hunter and D. Robinson, Structural features of oxide coatings on aluminium, J. Electrochem. Soc., 1953, No. 9.

[8] M. Hunter and P. Fowle, Factors affecting the Formation of Anodic Oxide Coatings, J. Electrochem. Soc., 1954, No. 10.

[9] Catalogue of the French firm SATMA on "Filoxal—Ruboxal."

[10] S. D. Kholodnyi, Conductors with Oxide Insulation, Trudy NIIKP, 1960, Vol. 5.

# Controllable Semiconductor Rectifiers

By K. G. KING, D.F.H., A.M.I.E.E.*

Summary of a lecture which the author delivered at a meeting of the Measurement and Control Section of the Institution of Electrical Engineers on 19th December

THE semiconductor-controlled rectifier, after several years' development both as to the device and to its methods of use, is now beginning to be used in many fields of power control, and can offer substantial advantages in respect of size, weight, efficiency, ease of design and installation, and facility of control.

A four-layer p-n-p-n device, the silicon-controlled rectifier stands in relation to the normal silicon diode as does the thyratron to the gas- or vapour-filled diode; that is to say, that it may be regarded as a silicon diode to which has been added a third electrode, the gate, by means of which the initiation of forward conduction can be controlled. In the absence of gate current it is virtually non-conducting in both directions, but upon being fired by a gate signal it triggers into a state of conduction, and so long as anode current continues to flow, exhibits a forward characteristic very similar to that of a diode. Units are currently available with voltage ratings up to about 500 V peak, and current ratings up to 100 A; larger types are under development. It is thus already possible to control large amounts of power with a small number of devices in a compact assembly.

Applications of controlled rectifiers to the control of electrical machines fall mostly into two categories, namely, field current regulation for output voltage control of generators, as it might be, for example, for the control of a Ward Leonard set or of an alternator driven by a prime mover, and d.c. motor speed control either by field control or by armature voltage control, together with less common applications such as motor starting, dynamic braking, etc.

## Direct-on-Line Starting

The simplest use to which controlled rectifiers may be put in machine control, albeit not at present an economic one except in special circumstances, is a.c. direct-on-line motor starting, for which intermittently rated controlled rectifiers can be connected in inverse-parallel pairs in the supply lines and operated purely as switches without any continuous control of voltage. Overload protection can readily be applied, and advantages are gained over conventional contactors in the ability to operate for extended periods without maintenance, lack of arcing and mechanical vibration, and efficient switching action without unnecessary disturbance to the supply.

For many applications of field or armature voltage control, where the performance requirements are not of the most demanding, the simplest type of controllable bridge rectifier, with half the arms containing controlled rectifiers and the other half diodes, is suitable. Control of the output voltage from zero to virtually the full supply voltage is obtained by applying firing pulses at a variable phase angle through the agency of a suitable driver circuit, which may be incorporated into an overall control scheme of any desired character. For example, in a motor speed control system, the firing angle may be governed automatically according to the comparison of a tacho-generator output with a reference, subject to over-riding control by a current transformer signal, giving a measure of the armature current, for the purpose of limiting the accelerating current and providing overload protection.

For better dynamic performance, the rectifier bridge may be controlled in all its arms, when it becomes capable of inversion, or returning power from the d.c. circuit to the a.c. supply, for by suitable phasing of the firing pulses the d.c. output voltage may, under appropriate conditions, be reversed. A single bridge of this type may be used in a current-forcing field control circuit or for armature control of a torque motor, where current flows only in one direction. By adding a reversing contactor or, alternatively, by connecting two bridges back to back, reversible current flow can be catered for. Such a system, which follows established mercury arc practice, provides a static equivalent of the Ward Leonard system, with full regeneration, and offers considerable savings in maintenance and other benefits. The economic comparison also does not appear to be unfavourable. A possible disadvantage in some cases lies in the low output power factor with reduced output voltages.

## Method of Switching Off

A different system of d.c. motor control depends on the use of the d.c. chopper regulator, which offers an almost loss-free method of controlling a d.c. supply, such as has not hitherto been available. Although controlled rectifiers cannot be switched off by gate control, the techniques are established whereby they may be switched off by the application of a charged capacitor; by connecting a controlled rectifier, so switched, between a d.c. supply and a load, and operating it at a high repetition frequency with a variable on/off ratio, the load voltage can be varied without the losses that would be incurred by using a series resistor. The major application so far to emerge for this principle is to the control of series motors in battery-driven electric vehicles, where the reduction in losses can effect considerable savings in battery capacity, but another interesting possibility is in armature voltage control of rectifier-fed motors, where it can show a considerable improvement over the controllable bridge rectifier in respect of input power factor.

For future development, much interest centres round the use of controlled rectifiers in operating commutatorless motors at variable speed, in order to obtain the advantageous operating characteristics associated with d.c. motors and at the same time eliminate the high cost, potential unreliability under some conditions, and maintenance difficulties that go with commutators. Such a development has been projected ever since static power switching devices were introduced, but it is only with the advent of semiconductors that the necessary switching characteristics—in particular the switching speed—and favourable economic aspects have brought its realisation within sight. It is hardly possible at this stage to say what forms such a system will ultimately take, since much work is involved both in the circuit development and in motor design, but sufficient has been done to predict that it should be strongly competitive with existing systems for many applications.

---

* Westinghouse Brake & Signal Co., Ltd.

# PANTOGRAPH TEST TRAIN

AN overhead equipment test unit capable of travelling at speeds up to 100 m.p.h. has recently been developed by British Insulated Callender's Cables, Ltd., in collaboration with the Eastern Region of British Railways. The unit comprises an instrumented coach, fitted with two pantographs, and a generator coach which provides the electrical power for the instruments, lighting and heating. An electrically-driven compressor in the generator coach provides the air supply for raising the pantographs.

The instrument coach was converted from a normal passenger vehicle to have a central observation dome and flat roofs at each end, both of which were fitted with Stone Faiveley type AMBR pantographs. The majority of the instruments are contained in a 12ft long and 6ft high panel secured to the coach floor and roof by anti-vibration mountings. The panel is mounted below a pantograph which is earthed to the coach and is designated the "dead" pantograph. This pantograph is used during tests when the overhead line is earthed and the test unit is being hauled by a diesel locomotive. At the opposite end of the coach is a high-voltage enclosure which is situated below a "live" pantograph insulated for 25 kV, which is used during tests with the overhead line live and with a diesel or electric locomotive hauling the unit. Arrangements have been made so that the electric locomotive can draw its power from the pantograph on the test coach so that the overhead equipment is not disturbed mechanically other than by the measuring pantograph.

The quantities which can be measured and recorded are pantograph height, acceleration, contact loss, contact pressure ("dead" pantograph only), locomotive current ("live" pantograph only) and train speed. In addition, track marks and timing marks can be inserted on all recordings. The recording facilities comprise one four-channel high-speed recorder and three two-channel plus event mark low-speed recorders. The former has a good frequency response up to 1,000 c/s and the latter up to 25 c/s. All recorder charts are driven by stepping motors controlled by a stepping switch transmitter attached to a velodyne unit, which receives its control signal from a tacho-generator attached to a coach axle. Chart speeds are therefore proportional to train speed. A track distance of 100ft is equivalent to chart lengths of 20 cm and 1in on the high- and low-speed recorders respectively.

Pantograph height is measured directly by a linear potentiometer 7ft long and driven by a lightweight glass fibre tube attached to the pantograph head. Strain gauge accelerometers attached to the height gauges measure the pantograph head accelerations. Contact pressure is measured by two strain gauge ring dynamometers fitted into the pantograph head, one at each side, the outputs being added to give the total force on the head. When running with the overhead line live, the line voltage is measured by an instrument transformer and displayed on a meter and recorded so that loss of electrical contact can be easily seen.

In the case of dead line running, a 300 V d.c. circuit is completed via the pantograph, the overhead line and earth. Loss of contact is measured by recording the voltage swing in a section of the circuit. Track marks can be inserted on all recordings either manually or automatically. A lamp and photo-cell unit, mounted under the coach floor and vertically below the pantograph, is arranged to operate the track mark unit from a piece of aluminium foil placed on the track. Manual insertion of track marks can be made by pressing buttons in the observation dome or on the instrument panel. The traction current taken by the hauling electric locomotive is measured by a current transformer on the connecting cable between the locomotive and the test unit.

*B.I.C.C. pantograph test coach for the Eastern Region of British Railways*

## New Harwell Course

THE first Harwell Reactor School course on the Instrumentation of Reactors will be held at Durley Hall, Bournemouth, from 12th to 23rd February next, inclusive. This course is designed to replace the Control and Instrumentation of Reactors course, which on the six occasions it was held was attended by over 250 students from Britain and overseas, excluding Authority staff. The fee for the new course will be fifty guineas, exclusive of accommodation. Details and application forms are available from the Manager, Reactor School, Atomic Energy Research Establishment, Harwell, Didcot, Berkshire.

# ATCOTROL

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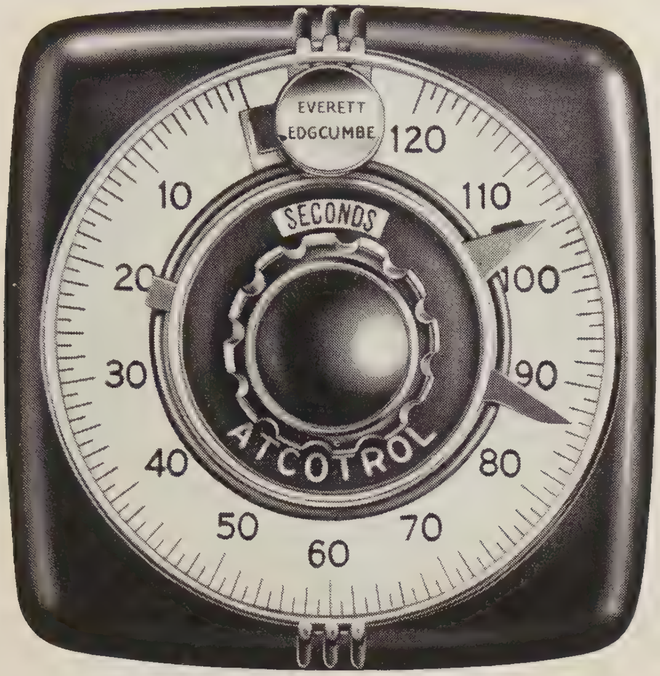
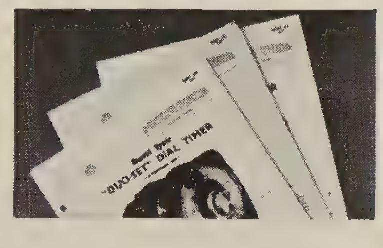


Atcotrol Miniature Process Timers, widely accepted by U.S. industry, are manufactured by arrangement with Automatic Timing and Control Inc., of Pennsylvania. Shown above is the Atcotrol 305 automatic reset dial timer, capable of handling up to six external load circuits. The percentage timer (Atcotrol 304) controls intermittent feed systems where a constantly repeated on-off switching cycle is required.

The duo-set dial timer (Atcotrol 306) controls two independently adjustable load circuits on a continuously repeating duty cycle, e.g., in process reversal. Timer designs are matched, with a front dimension 3¼″ square and incorporate one-hole fitting.



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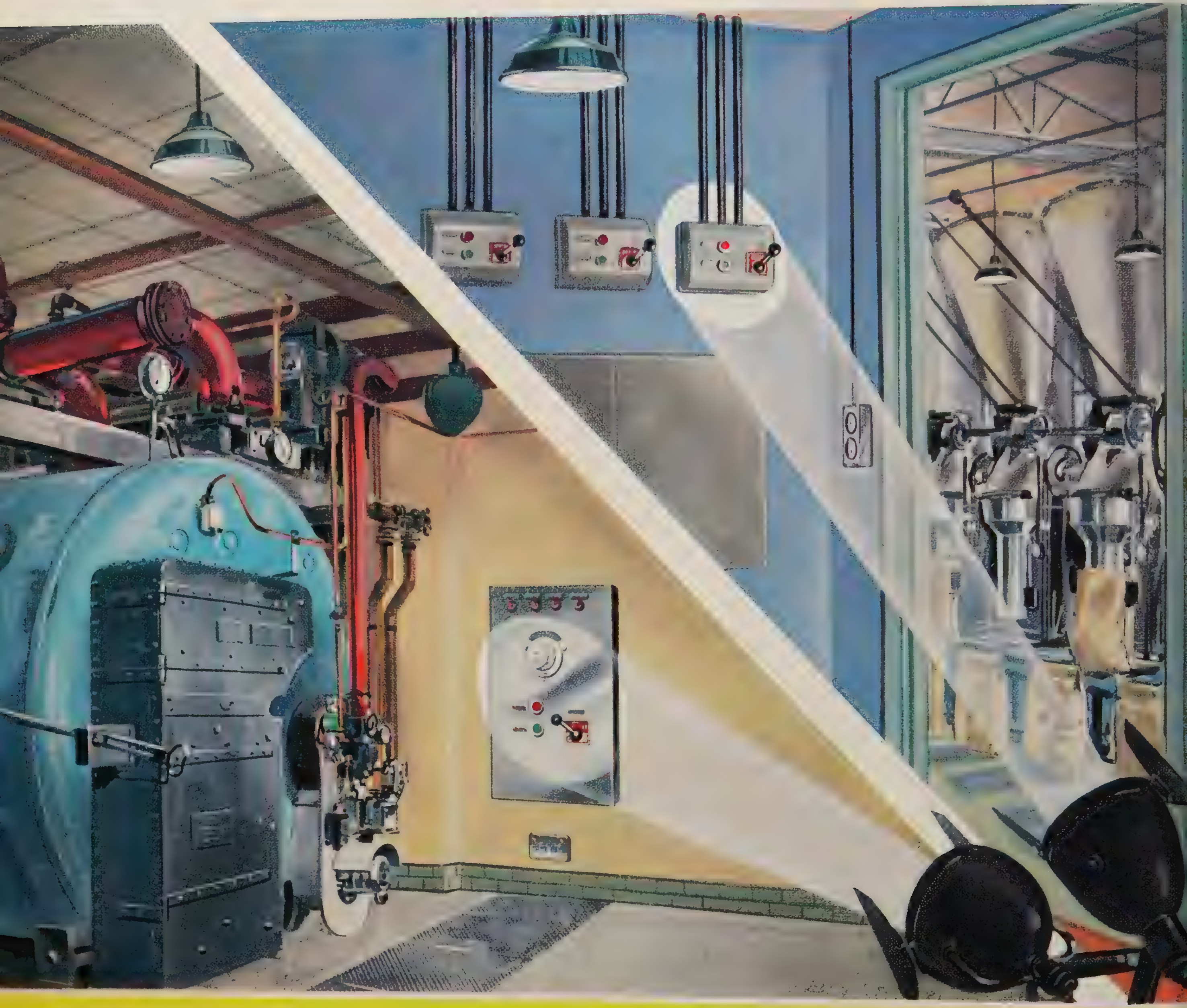
PAM 701

# SPOTLIGHT ON A GOOD INSTALLATION



Some installations call for special purpose control centres as shown in the pictures above. The majority of requirements, however, can be met by the assembly of Crabtree starters, push-button stations, circuit breakers, pilot lights and other components in any one of a wide range of standardised control panels. The accompanying illustration shows a typical standard panel suitable for floor mounting.

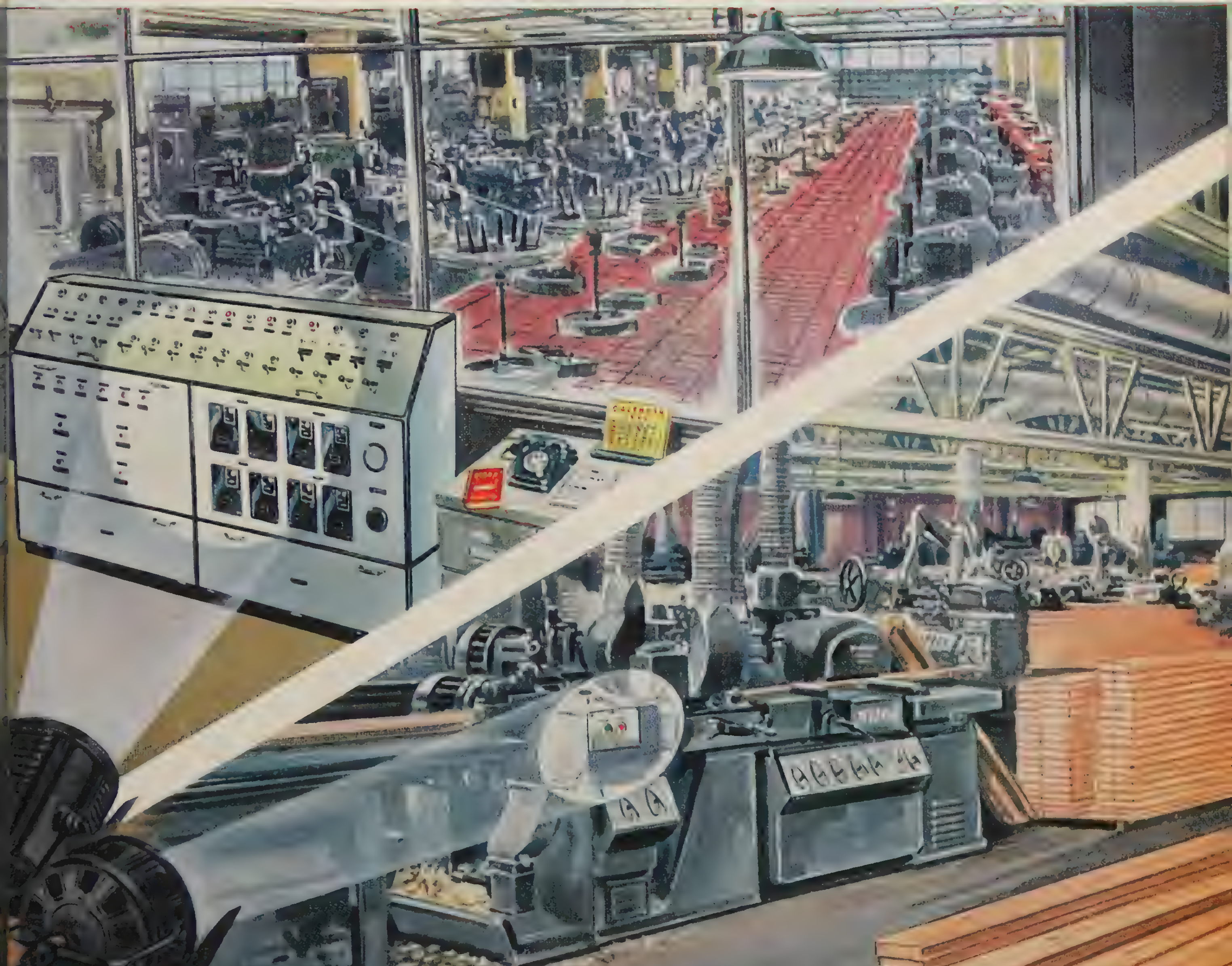
A typical industrial switch assembly — built up from the standardised components of the Crabtree ' Closegang ' range—in which an all-steel case affords complete protection to the nylon operating dollies.

A typical Crabtree Type "B" control unit embodying a direct on starter, 5-pole isolating switc and H.B.C. fuses in a heav industrial case. The range include reversing pole-changing and star delta starters with and withou on-load isolating switches and/o H.B.C. fuses.

**is example of a Crabtree socket-**
**tlet assembly provides a twin**
**itched unit with pilot lights and**
**etal front plate in iron box, the**
**sily accessible switch dollies being**
**unbreakable nylon construction.**

**This moulded lampholder, from the varied Crabtree range, is provided with a protective shield and a cable entry and cord grip suitable for cab-tyre or workshop flex. (The lighting fittings shown in the pictures below are by C. M. Churchouse Ltd.)**

**In this type of Crabtree remote control station, the popular push-button interior is mounted in a weatherproof case which has been cadmium plated and bonderized before enamelling. Other types of station include general purpose units with steel and iron cases, flush-mounting stations with brass front plates and suspension units with aluminium cases.**



Whilst the extensive employment of Crabtree products on industrial installations is a testimony to their proved reliability, the popularity of Crabtree control gear is also due to the very wide degree of component standardisation which has been achieved. This gives the works engineer the advantage of complete interchangeability between the vital parts of every type of starter over a wide range of horsepower sizes. It is because they are so dependable and so easy to maintain that Crabtree products will be found throughout the modern factory in control of every kind of lighting, heating and power circuit.

**CRABTREE**

J. A. CRABTREE & CO. LTD., LINCOLN WORKS, WALSALL, STAFFS.

"Scafell Pike" is one of the first of 193 "Peak" Class 2,300 to 2,500 h.p. 90 m.p.h. diesel-electric locomotives for the London Midland Region of British Railways. Photograph by courtesy of British Railways.

There's M & I electrical insulation in "Scafell Pike" and in many more like her

Traction motor armature for one of the new diesel-electric locomotives for British Railways. Photograph by courtesy of Crompton Parkinson Ltd.

M & I, Micanite V-rings and segment separators will be fitted in the generators and traction motors of 282 diesel-electric locomotives, of three distinct types, ordered for British Railways' Modernisation Scheme.
The various classes of these locomotives will be hauling all types of traffic from the fast "Mid-day Scot" and other main line expresses and fast freight trains to short haul passenger and freight services throughout the country.
The main contractors for the electrical equipment of the locomotives are Crompton Parkinson Ltd. and we are proud of our contribution to this project.

M & I MAKE EVERY FORM OF MICANITE FOR ELECTRICAL INSULATION

*Please write for full details*

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the electrical insulation people
THE MICANITE & INSULATORS CO., LTD.,
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TELEPHONE: LARKSWOOD 5500. TELEGRAMS: MYTILITE, LONDON, TELEX. TELEX: 25183

# New Yorkshire Power Station

## *FOUR 500 MW SETS FOR EGGBOROUGH*

THE Central Electricity Generating Board has placed an order with the Foster Wheeler, John Brown Land Boilers Consortium for the design, construction and installation of four 500 MW reheat boilers. These four units will be installed in the power station now being built at Eggborough, on the River Aire, near Selby, Yorkshire, which will be one of the largest in Western Europe. This will be a coal-fired installation and will require about 19,200 tons of coal per day. The first boiler is scheduled to be commissioned in 1966 and the remaining three units during 1967 and 1968. Each boiler will have the following steam conditions: evaporation, 3,350,000 lb/hr, pressure at superheater outlet 2,400 p.s.i., temperature at superheater outlet 1,055°F, reheat outlet 1,055°F, reheater flow 2,620,000 lb/hr, feed temperature for each unit at c.m.r. 490°F.

Three main and two mill air preheaters of Rothermuehle design are to be supplied for each boiler by Davidson & Co., Ltd., making this the first installation of its kind in the United Kingdom. The economisers will be of the steel gill welded type by E. Green & Son, Ltd.

### First Unit Ready in 1966

Associated Electrical Industries, Ltd., have received an order from the C.E.G.B. valued at nearly £14 million for 2,000 MW of generating plant for the station. This comprises four 500 MW, 3,000 r.p.m. single shaft turbo-generators, condensing plants and auxiliary turbine driven boiler feed pumps. The first unit is due for commissioning in 1966 and all four units are scheduled to be in operation by 1968.

The single shaft unit of 500 MW is a later development of the 550 MW double shaft unit already being manufactured by A.E.I. which is the highest rating of unit so far ordered in this country.

The 500 MW design, which concentrates the maximum capacity up to the present in a single shaft unit, will result in the most economical generation project in terms of capital and operation costs and thermal efficiency. The unit will consist of a five-cylinder, 3,000 r.p.m. reheat turbine for steam inlet conditions of 2,300 p.s.i.g., 1,050°F, the steam being reheated after the first high pressure cylinder to a temperature of 1,050°F. The turbine is directly coupled to a 500 MW two-pole generator and hydrogen and water are used as cooling media.

A quantity of steam is tapped off the turbine after the high pressure cylinder to supply a turbine of approximately 15,000 b.h.p. output for driving the main boiler feed pump.

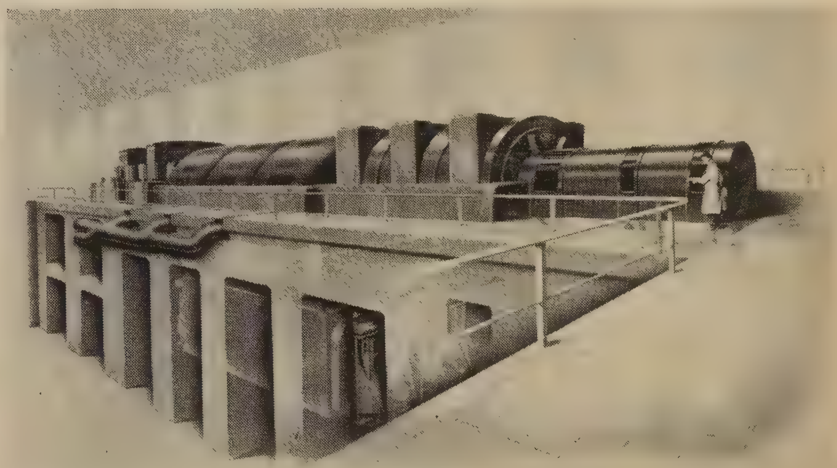
The main turbine consists of high pressure, intermediate pressure and three low pressure cylinders. The rotor of each cylinder is supported by two bearings and all rotors are solidly coupled together. The assembly of cylinders is anchored to the foundations at the low pressure end, the rotor assembly being fixed relative to the cylinders by a thrust block at the high pressure end. The design incorporates devices to accommodate with safety the large differential expansion between rotors and cylinders calculated for a machine of great length. A.E.I. turbovisory equipment to supervise closely differential expansion, rotor eccentricity and vibration is included in the plant.

The steam exhausting from the h.p. cylinder passes to the reheater and re-enters the turbine in the centre of the double-flow intermediate pressure cylinder. The steam exhausting from each end of this cylinder is distributed by pipes to the three l.p. cylinders, each of which is arranged for double flow. The six exhausts from the turbine are connected into an exhaust piece to which the condenser is bolted. The condenser is of special design and is arranged axially under the turbine. The designed condenser vacuum is 28·7in Hg at full load.

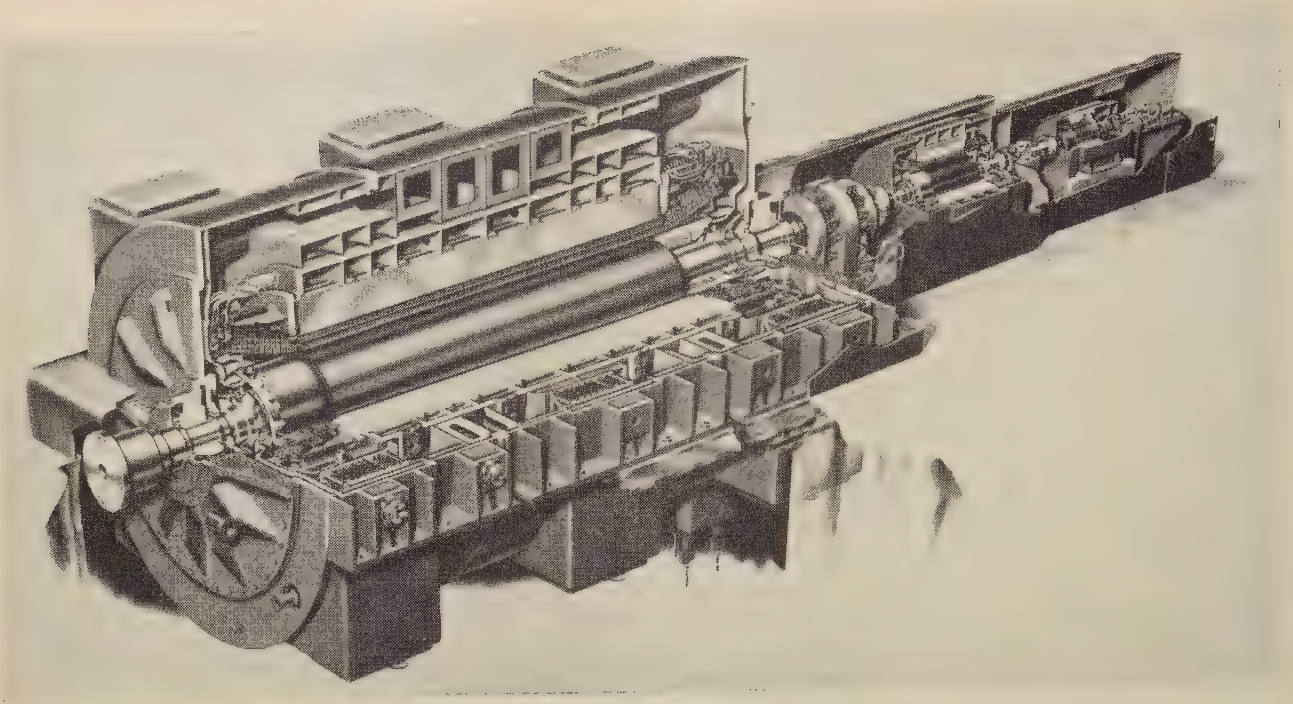
A turbine of about 15,000 b.h.p. capacity operates in conjunction with the main turbine for driving the main boiler feed pump. The steam supply is taken from the main turbine after the high pressure cylinder. This turbine is arranged as a bled steam, back pressure machine, the steam tapped from the various stages and the exhaust steam is used for feed water preheating. The feed heaters are to be supplied by Hick, Hargreaves & Co., Ltd.

### Generator Design

The generator is designed for three-phase, 50 c/s, 22 kV, 0·85 power factor and 0·4 short-circuit ratio. The generator is cooled by hydrogen at 45 p.s.i. and, in addition, the stator windings are direct water cooled. The stator conductors are in the form of hollow copper tubes,



*Artist's impression of 500 MW A.E.I. turbo-generator*



*Perspective cut-away view of 500 MW generator*

through which cooling water is circulated between manifolds at both ends of the windings. The water is passed in closed circuit through heat exchangers where the heat generated in the stator windings is extracted for return to the feed water system and thereby recovered in the turbine cycle.

The generator rotor and the stator core are cooled by hydrogen at a pressure of 45 p.s.i. The rotor consists of a solid forging with windings arranged for cooling in direct contact with the copper.

To carry the hydrogen into direct contact with the rotor copper, a series of axial and radial passages are constructed by grooving the copper axially and punching slots radially through each turn. Hydrogen is fed to the radial slots through openings in the insulation arranged at intervals along the length of the coil and after passing axially through the grooves is discharged to the air gap from adjacent radial slots. This arrangement ensures uniform cooling throughout the length of the rotor. For cooling, the stator core hydrogen is circulated by fans mounted on the shaft, through radial ducts provided in the core. The hydrogen circulated through the rotor and stator core is cooled by heat exchangers built into the generator casing. By using condensate as the cooling medium, the stator heat losses are recovered in the turbine cycle.

The excitation source is a direct-coupled, four-pole a.c. generator, the output of which is rectified by a bank of silicon rectifiers directly connected to the main generator slip-rings. An automatic voltage regulator varies the a.c. generator excitation to suit the load requirements of the generating unit. The use of this system avoids the gearbox drive and large diameter heavy current commutators which would be necessary with direct current exciters.

The condensers are of a novel axial design which marks a significant advance in the development of surface condensers for handling large quantities of exhaust steam from large capacity turbines. Each unit has a total cooling surface of 300,000 sq ft and has been designed to overcome the problems of turbine foundation supports associated with transversely arranged condensers. Further features are the special provision for completely balancing the hydraulic thrust of the very large cooling water pipes and the double tube plates which enclose a pressurised space and eliminate the possibility of cooling water leaking into the condensate at the tube fixing.

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## NEW I.E.E. DIVISIONS

EACH member of the Institution of Electrical Engineers, other than student members, will receive a circular concerning the new divisional structure of the Institution with the December issue of the Institution Journal. The circular incorporates a form on which members are invited to register for one or more of the three Divisions which will replace the Specialised Sections on 1st October, 1962. Members are also asked to indicate their interest in the appropriate professional groups within the proposed new Divisions. Ten professional groups are listed in each of the Power and Electronics Divisions of the Institution and eight in the Science and General Division.

Registration for the Science and General Division is open to all members, but when applying for membership of the other two Divisions, members are asked to give a brief outline of their professional interests, including present occupation. This is, however, the same procedure at present applying to registration for the Specialised Sections. After registration, a member will be regularly informed of papers, programmes and other activities of the professional groups he has specified and of the general activities of the Division or Divisions concerned.

# *VIEWS on the NEWS*

### *By "REFLECTOR"*

THE electrical industry successfully fought proposals that purchase tax should be charged on underfloor heating systems, but now another possibility is rearing its ugly head. The *Southern Evening Echo* reports a meeting of the New Milton, Barton-on-Sea and District Ratepayers' Association at which a strong protest was made following an announcement that the sum of £2 had been added to the rateable value of a number of bungalows for what the Rating Department considers to be an "additional amenity." It was stated that two residents had managed to have this extra impost removed and the others should be similarly treated. It is extraordinary that a rating authority should seek to tax what is, after all, an alternative to other forms of heating in the home.

* * *

Although the residents in the area are said to be unconcerned at the Central Electricity Generating Board's proposal to erect supergrid lines from Bangor across the Conway Valley into Denbighshire, the amenity societies are very perturbed about it. Once again it is being urged that the line should be buried, and the *Llandudno Advertiser* points out that

> "After all, the Wales Gas Board managed to lay their grid system for gas distribution underground over a very long mileage."

This is making a virtue of a necessity. Overhead gas mains would really be something to protest about.

* * *

A photograph has reached me from a Japanese concern illustrating an incandescent filament lamp measuring about 53 cm in diameter and 92 cm long. It is rated at 50 kW which probably entitles the makers to claim that it is the largest lamp in the world. They also say that "it can operate on ordinary house current—100 volts." Perhaps a Japanese domestic installation could stand it, but I have my doubts.

* * *

The traditional British open coal fire, like Charles II, is an unconscionably long time a-dying. Naturally, it is the elderly who are loath to let it go, although one member of the Folkestone Town Council (who is a chimney sweep) contended at a recent meeting that young people liked it too. The Council decided, however, not to provide coal fires in the homes for old people which it is building, but to install electric or gas heating. The chairman of the Housing and Town Planning Committee described the decision as far-seeing. He said that the middle-aged people of today were the old people of tomorrow. Those who would ultimately occupy the dwellings would have grown up in an age of electricity and gas. The Chanctonbury Rural Council, I see, has gone one step further. It has decided not to install gas in some old people's homes in that Sussex area—only electricity.

* * *

Most people think that, apart from the deposits in Northern Ireland, Ireland relies for its coal supplies on imports, or burns peat. Yet at the recent annual dinner of the Irish Mining and Quarry Society in Dublin, Mr. Erskine Childers, Minister for Transport and Power, said that Irish anthracite producers had already obtained a foothold in the export market and membership of the European Economic Community (for which the Republic has applied) should provide them with an opportunity for expansion. But he went on to refer to difficulties in disposing of Arigna coal "due to competition from imported and other fuels." The Arigna output is quite small—about 65,000 tons a year. Of this, 45,000 tons is taken for the Electricity Supply Board's local station and a limited amount for the Ringsend (Dublin) power station, leaving only about one-sixth for other purposes—a tiny amount for export, I should think.

* * *

During the last decade or so of the last century the *Electrical Review* gave much critical attention to the affairs of the Elmore companies, a group engaged in producing various copper manufactures. The accounts of some of these companies were briefly summarised in the issue of 25th December, 1891; the summaries were accompanied by the following note which was by no means imbued with the spirit of the festive season:—

> "We regret that the accounts and reports of the above Elmore Companies reached us too late to give them the extended notice they require, but attention may be drawn to the absence of information of the prospects of the companies from a commercial standpoint, and the reliance by the directors on the estimates of the managing director, which are much the same as those other estimates which have not been realised."

* * *

Once more I extend my best wishes for Christmas and the coming year to my readers and thank all those who have helped me to keep these comments going during 1961.

# PERSONAL AND SOCIAL

## *News of Men and Women of the Industry*

British Insulated Callender's Cables, Ltd., announce that in view of the growth in the activities of the B.I.C.C. Group in recent years the chairman, **Sir William McFadzean,** is at his own request relinquishing the office of managing director in order to be free to concentrate on overall policy and the national and international aspects of group affairs. He remains executive chairman. In this capacity he will be responsible to the board for supreme executive policy and the overall co-ordination of the company and group, but will delegate executive operation to **Mr. R. M. Fairfield** and **Mr. W. C. Handley,** at present assistant managing directors, who will become joint managing directors. **Mr. H. F. Akehurst,** at present assistant managing director, will become executive director (export) and **Mr. W. Fraser,** at present a director, will become executive director (overseas companies). These changes take effect from 1st January.

*Sir William McFadzean*

*Mr. R. M. Fairfield*

*Mr. W. C. Handley*

*Mr. H. F. Akehurst*

*Mr. W. Fraser*

*Mr. F. C. Walmsley*

**Mr. F. C. Walmsley,** M.I.E.E., Mem.A.I.E.E., is joining British Insulated Callender's Cables, Ltd., on 1st January as assistant divisional manager of the Capacitor Division at Helsby, Lancs. Mr. Walmsley studied at Queen Mary College and London University, and continued his training with the Metropolitan-Vickers Electrical Co., Ltd., Manchester. From there he moved to the Micanite & Insulators Co., Ltd., and later worked with the Middlesex County Council and the Air Ministry. He subsequently rejoined Micanite & Insulators where for several years he has been responsible for the engineering activities in the high voltage bushing and insulator fields. He has served on Committees of the British Electrical and Allied Manufacturers' Association, the British Standards Institution and the Electrical Research Association and attended meetings of the International Electro-technical Commission and is at present serving a second period of office on the Supply Section Committee of the Institution of Electrical Engineers.

**Mr. P. Briggs,** A.M.I.Mech.E., M.Inst.F., director of the North Eastern Region of the Central Electricity Generating Board, has been appointed a full-time member of the Electricity Council, with effect from 1st January. He will have special responsibilities for industrial relations, reporting to the chairman of the Council. Mr. C. T. Melling, who has hitherto been responsible for industrial relations, became a deputy chairman of the Council last August and has therefore taken over the technical duties discharged by his predecessor, Sir Josiah Eccles. **Mr. C. G. Richards,** M.Sc.Tech., A.M.I.Mech.E., A.M.I.E.E., deputy regional director of the North Eastern Region, will succeed Mr. Briggs as regional director, and **Mr. W. Wilde,** B.Sc.(Eng.), M.I.Mech.E., M.I.E.E., M.Inst.F., assistant regional director (South Wales Division) of the South Western Region, will take the position vacated by Mr. Richards.

*Mr. P. Briggs*

*Mr. J. C. George, Parliamentary Secretary, Ministry of Power, visited the headquarters of the Midlands Electricity Board at Halesowen on 13th December. He is seen here being welcomed by the chairman of the Board, Mr. W. S. Lewis (right) and Mr. Garnet F. Peirson, the deputy chairman (centre), who will succeed Mr. Lewis as chairman on his retirement on 31st December*

Mr. Briggs, who received his training with Peter Brotherhood, Ltd., held posts at Islington and Fulham power stations, becoming superintendent at Fulham in 1945. He was chief generation engineer (operation) of the South Eastern Division of the British Electricity Authority between 1948 and 1953, divisional controller, Merseyside and North Wales Division, from 1953 to 1954 and deputy controller, North West, Merseyside and North Wales Division, from 1954 to 1957. In 1957 he was appointed director of the North Eastern and Yorkshire Region.

*Mr. C. G. Richards*

*Mr. W. Wilde*

Mr. Richards began his career with Metropolitan-Vickers, with whom he served a college apprenticeship, joining the company's outside erection staff in 1928. From 1931 to 1945 he was employed by the Singapore Municipality, first as power station engineer and later as distribution engineer. He was generation engineer with the Sheffield Corporation Electricity Department before becoming, at vesting date, chief generation engineer (operation) of the Yorkshire Division, and has been divisional controller of the Yorkshire Division since 1958.

Mr. Wilde started with the Sheffield Corporation Electricity Department, where he held several engineering posts at Blackburn and Neepsend power stations. After a period with the Newcastle-on-Tyne Electricity Supply Co. he joined the Lancaster Corporation as charge engineer, and in 1926 he became combustion engineer with the London Electricity Supply Corporation at Deptford East station. He was appointed generation engineer (operation) of Group II of London Division's power stations in 1948, later becoming chief generation engineer (operation), London Division.

The Minister of Power has reappointed **Mr. Benjamin Pickup,** C.B.E., J.P., of Gatley, Cheshire, as a part-time member of the North Western Electricity Board. **Mr. G. A. Howe,** M.A., LL.B., F.C.A., retires from part-time membership of the Board on 31st December.

**Mr. W. S. H. Whitehead,** for many years export manager of Morphy-Richards, Ltd., has been appointed overseas marketing manager of G.E.C. (Domestic Equipment), Ltd.

**Mr. A. W. Bunn** has retired from the positions of deputy general sales manager (home) and field sales manager of Hoover, Ltd., after nearly 32 years with the company.

**Mr. P. A. D. Duffell,** until recently manager of the Hoover organisation in Germany, has taken up the appointment of field sales manager. He joined the company in 1951.

George Kent, Ltd., have appointed **Mr. R. C. Ingram** to the newly created post of marketing manager. Mr. Ingram, who is 44, joined the company as a student apprentice in 1934 and later became manager of the first nuclear section of production control, which was responsible for the instrumentation for Harwell's first large-scale reactor and, later, for equipping both reactors at Windscale.

*Mr. R. C. Ingram*

The annual Ladies' Night of the **Association of Supervising Electrical Engineers** was held at the Connaught Rooms, London, on 16th December. In keeping with the festive nature of the occasion, speechmaking was kept to the minimum, the only toast being that to the ladies, proposed by the chairman of the Association, Mr. W. G. D. Gregg. A brief response was made by Lady Jackson, wife of the Association's president, Sir Willis Jackson. Carols were sung by the augmented Court Singers and a cabaret and dancing concluded an enjoyable evening.

*At the Dickens anniversary dinner of the Royal Commercial Travellers' Schools. Left to right: Mr. George Walker, Captain P. G. C. Dickens, Sir Alan Herbert, Mr. Arthur T. Haywood, Sir Leslie Gamage and Mr. Cyril Harvey, chairman of the Schools' Board of Management*

**Mr. A. Haselhurst,** A.A.C.C.A., A.C.W.A., who has been chief commercial officer of the Yorkshire Electricity Board since 1948, is to retire on 31st December. Mr. Haselhurst was commercial manager and deputy chief official of the Bradford Corporation Electricity Department from 1941 to 1948 and was previously with Willesden Corporation and Hull Corporation Electricity Departments.

*Mr. A. Haselhurst*

*Mr. C. Booth*

Also retiring at the end of the year, after 40 years' service in the electricity supply industry, is **Mr. C. Booth,** M.I.E.E., who has been manager, No. 2 (Huddersfield) Sub-Area, Yorkshire Electricity Board, since 1952. From 1946 to 1948 Mr. Booth was borough electrical engineer and manager at Dewsbury.

**Mr. C. R. Wheeler,** C.B.E., has been appointed chairman of the British Standards Institution's Export Panel which advises on matters of major policy in relation to B.S.I.'s work affecting export trade. Mr. Wheeler is president of the British Iron and Steel Federation and deputy chairman of Associated Electrical Industries, Ltd.

The 150th anniversary of the birth of Charles Dickens and his association with the **Royal Commercial Travellers' Schools** was celebrated at a dinner held at the Fishmongers' Hall, London, on 7th December. Proposing a toast to the Schools, Mr. George Walker, O.B.E. (director of A.E.I. central services and company secretary), said that they had a very important part to play in the future of the country and would need all the support they could get. Responding, Sir Leslie Gamage, M.C., M.A. (chairman of Pirelli-General Cable Works, Ltd.), president of the Schools, said they were extremely proud of the fact that although the Schools had been established well over 100 years they had never had, or asked for, any assistance from the Government. They were completely independent. The toast to the " Immortal Memory," proposed by Sir Alan Herbert, was responded to by Captain P. G. C. Dickens, D.S.O., D.S.C., R.N. (great-grandson of Dickens). Mr. Arthur T. Haywood, president of appeal (managing director of Electrical Components, Ltd.), presided.

**Mr. A. C. Robb,** M.Eng., Ph.D., A.M.I.E.E., formerly technical manager of Belling & Lee, Ltd., now becomes technical director, and **Mr. J. R. Turrill,** formerly sales manager, becomes sales director.

**Mr. E. Jones** has been appointed executive director of Field & Grant, Ltd.

**Mr. V. R. Prehn,** managing director of Ruston & Hornsby, Ltd., is retiring on 31st December. He is succeeded by **Mr. C. T. Alderson,** J.P., M.A. (Cantab.), who since the beginning of this year has been deputy managing director.

## OBITUARY

**Mr. J. F. Stedman.**—The death has occurred of Mr. J. F. Stedman, superintendent electrical engineer at Fenham Barracks, Newcastle-on-Tyne.

# *Parliamentary Report*

## Increasing Borrowing Powers

Members on both sides of the House of Commons were warm in their tributes to the electricity supply industry in the debate on the Electricity (Borrowing Powers) Order, 1961, and a similar order affecting Scotland.

The Minister of Power, Mr. Richard Wood, who opened the debate, said the Government expected from the industry as a whole in England and Wales total surpluses of about £325 million over the five-year period between 1962-63 and 1966-67, an average of £65 million a year. About half of this was expected to come from the Central Electricity Generating Board and the remaining half from the Area Boards. On present estimates of capital requirements, this level of performance represented a gross yield on average net assets employed of about 12½ per cent and a net yield after depreciation of nearly 7 per cent. A performance at this new level implied a self-financing ratio rising from about 50 per cent at the beginning of the five-year period to nearly 60 per cent at the end of it. All these figures applied to the industry as a whole; figures for each Board individually would be published when consultations were complete.

Explaining the purpose of the Orders, Mr. Wood reminded M.P.s that the Electricity Borrowing Powers Act, 1959, gave to the Electricity Council and Boards in England and Wales and to the South of Scotland Electricity Board power to borrow up to the limits, respectively, of £2,300 million and £135 million. It also laid down intermediate limits of £1,800 million and £110 million, respectively. These were the limits at present in force. The purpose of the Orders was to raise those limits to the maximum figures provided for under the 1959 Act. This fitted in perfectly satisfactorily with the forecasts made three years ago.

Capital requirements in the last three years had been rather less than was estimated in the case of the Electricity Council—£844 million instead of £850 million. For the South of Scotland Electricity Board the probable outturn to 31st December this year was about £1 million below the estimate. Rather more than was expected in 1958 had been met from internal resources, £360 million against the expected £355 million. Therefore, in the case of those Boards the borrowing required was about £11 million less than was expected. In the case of the South of Scotland Board, because self-financing had been a little less than was expected, the borrowing required was exactly as estimated three years ago.

The financial out-turn so far in the last three years was consistent with the expectations in 1958, but the plans for the remaining years of the period had changed because the demand was now growing at a faster rate than was foreseen three years ago. In order to meet this, the industry had had to accelerate plant commissioning programmes and increase the planned level of investment on main transmission and distribution. The margin of spare capacity in the later 1960's would be rather less than 2½ per cent in average cold winter conditions and even smaller in the intervening years.

The recent growth in demand and the technical advances of the last few years had made necessary a re-examination of the methods of providing the additional generating capacity which would be necessary during the decade. It was now planned to provide by 1968 about 5,000 MW of nuclear capacity which would probably reduce the industry's capital needs up to 1966 by £90 million. In conventional electricity generation there had been great technical progress too, and the cost per kW was now down to £40 and in the later 1960s it might well be down to £35 or lower. Through increased thermal efficiency there had been a decrease in running costs too.

The increased demand had led to the necessity for increased capacity in main transmission. The Central Electricity Generating Board was planning to introduce a 400 kV main transmission network, and at the same time the increased demand also meant increased expenditure on the Area Boards' distribution systems. He was fully satisfied that the industry recognised the prime importance of a high load factor.

The Orders were approved.

## Rating Electricity

There is to be a general review of the electricity rating provisions of the Local Government Act, 1958, after the new valuation lists come into force in 1963, Dr. Charles Hill, the Housing Minister, has told M.P.s.

He was answering a question from Mr. Leather (Con., North Somerset), who had asked if the Minister was aware that under the Rating and Valuation Act, 1961, the Commissioners of Inland Revenue had considerably reduced the assessments of power stations, with consequent loss of revenue to local authorities in whose areas those stations were situated. Mr. Leather also asked if the Minister was ready to put forward proposals to compensate local authorities.

Dr. Hill said that until the review the local authorities qualifying for rate deficiency grant received automatic compensation for any fall in rate resources.

## Nationalisation in Hong Kong

Mr. Hugh Fraser, Under Secretary for the Colonies, has refused a Commons request that he should direct the Governor of Hong Kong to implement the main recommendation of the Electricity Supply Commission's report, dated December, 1959, to take into public ownership the two electricity supply companies in the colony.

Mr. E. Thornton (Lab., Farnworth) asked if Mr. Fraser realised that the electricity companies had made it quite clear to the Commission that there was no half-way house between public ownership and unfettered private ownership. "Does not the well-known doctrinaire dislike of nationalisation by the present administration put the private electricity power companies in a very strong bargaining position ? " he asked.

Mr. Fraser replied that he had full confidence in the way in which the Governor was handling the matter. There was no evidence that the present negotiations had affected the supply of electricity to the consumers. Furthermore, the restriction on the distribution of dividends had created a large reserve which could be put to good use in the necessary development of electricity supplies in the colony.

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## English Text of Common Market Tariff

The Board of Trade have prepared an English translation of the External Tariff of the European Economic Community. This has been done with the permission of the E.E.C. Commission but the text has not been cleared with them nor with member Governments of the Community and the Board of Trade are solely responsible for it.

The translation will be available in eleven parts and the first (Chapters 84-89 of the Brussels nomenclature), which includes electrical equipment, was published on Tuesday (H.M. Stationery Office, price 4s).

## INDUSTRIAL NEWS

# Volta River Loan Approved

THE United States Government has agreed to grant loans to Ghana for building the dam and aluminium smelter that form part of the Volta River project.

The dam, power station and transmission lines are expected to cost about £70 million and take five years to complete. The United States is providing over £13 million and the remaining funds will come from the International Bank (£17 million), Britain (£5 million) and Ghana (£35 million). In addition the United States will extend loan assistance totalling about £34 million, as well as investment guarantees, to a consortium of American companies who will build and operate the aluminium plant. It was the difficulties that this group experienced in getting finance that delayed final agreement on the scheme.

Work on the project has been going ahead since a contract was granted to the Italian Impresit consortium last April. The contract for generating and transmission plant is due to be awarded by the end of this month.

### Hoover Extensions at High Wycombe

Additional premises adjoining their High Wycombe, Bucks., factory have been acquired by Hoover, Ltd. Vacuum cleaner and polisher spare parts are already being manufactured in the new building. The total area of the High Wycombe factory, where steam-or-dry iron and spare parts for many of the company's products are made, is now 86,276 sq ft.

# Nuclear Research Collaboration in Europe

THE Steering Committee of the O.E.C.D. European Nuclear Energy Agency has approved proposals for joint work on reactor physics, direct conversion of nuclear heat to electrical energy, electronic computation and data processing, and very high flux reactors, following recommendations by the Agency's top level group on nuclear research, which met last October under the chairmanship of Professor Francis Perrin, French High Commissioner for Atomic Energy.

It is intended to set up an international committee charged with reviewing work under way in reactor physics, collating and disseminating results, and advising on the allocation and co-ordination of work undertaken within the various national research programmes. On direct conversion, an expert symposium will be held to review the present state of research and suggest a programme for future international co-operation. It is intended to limit action in this field to the thermo-ionic and magneto-hydrodynamic aspects of direct conversion.

A technical seminar on electronic computation and data processing is to be arranged to examine new trends in this field and the possibilities for joint activities, for example in setting up centralised libraries of programmes and codes, or in developing specialised equipment for atomic energy problems.

For very high flux reactors, a meeting of scientists is to be convened to discuss requirements for much higher fluxes than are at present, or soon will be, available for use in experimental studies such as those of changes in structure of nuclear materials subjected to intense irradiation. The possible construction and operation of a very high flux reactor on an international basis, to provide a new centre for physical, chemical and other investigations, will also be examined.

### POWER TRANSMISSION DISPLAY

An exhibition is being held at the Science Museum on two new projects in electrical transmission, the cross-Channel power link, and the new 400 kV overhead line crossing over the River Thames at West Thurrock. The exhibition opened on 8th December and will continue until mid-February.

### Electrical Engineers Exhibition

The Minister of Aviation, Mr. Peter Thorneycroft, will open the eleventh Electrical Engineers (A.S.E.E.) Exhibition at 12 noon on Tuesday, 20th March next. Each year a special section of the exhibition is devoted to a particular aspect of the electrical industry and in 1962 the feature will be "Electricity in Aviation." In a display area covering 5,000 sq ft the R.A.F. and the Ministry of Aviation will be showing a comprehensive range of electrical apparatus, accessories and components used in aircraft and on the ground.

### E.T.U. NOT TO APPEAL

The Electrical Trades Union is not to proceed with its appeal against the judgment of Mr. Justice Winn in the "ballot-rigging" case. This was announced after a meeting of the Executive Council at the week-end. As already reported, four of the five personal defendants in the High Court case have asked for leave to withdraw their appeals. The fifth, Mr. Frank Foulkes, general president of the Union, has said that he will appeal even if he has to defend himself. He has been refused legal aid.

### Plessey to Manufacture American Switches

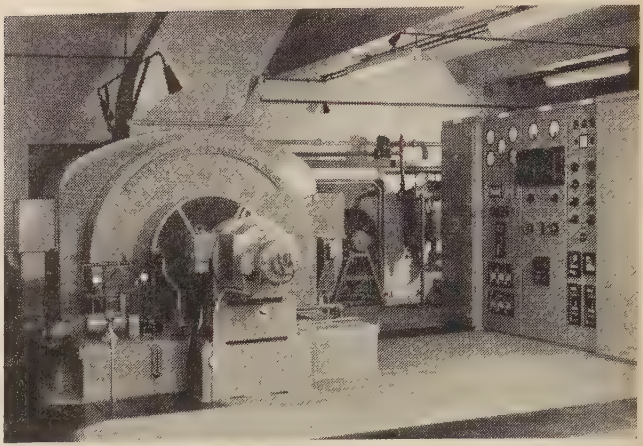
The Plessey Co., Ltd., has concluded a licence agreement with Illinois Tool Works Inc. of Chicago and its subsidiary, ITW, Ltd., of Slough, Buckinghamshire, whereby Plessey will manufacture (at its Havant factory) and market the range of "Licon R" precision snap-action switches in Britain.

*The permanent floodlighting of the eastern face of Sydney Harbour Bridge has been completed recently by British General Electric Co. Pty., Ltd. The installation uses some 140 specially manufactured floodlights. MB/U lamps have been used on the bridge itself and the pylons are illuminated by the new 500 W Osram tungsten iodine lamps. The G.E.C. also supplied the lighting for the public spaces in the S.S. Canberra seen in the foreground*

# Industrial Turbo-Generator

THE first Bristol Siddeley 3 MW turbo-generator to be ordered specifically for private industrial use went into service on 14th December. The set has been commissioned by English Clays Lovering Pochin & Co., Ltd., and will be used to meet the demands of their china clay works in the St. Austell area of Cornwall. The company already has extensive steam-turbine generating equipment at its Nanpean central generating station.

The new 3 MW set, which can be remotely controlled from that station, is sited at Bugle, some five miles away, and will supplement the existing steam-driven machinery. The new plant will be used to preserve both the integrity of supply in case of a power failure and also at "on-peak" maximum demand periods during the winter months. The illustration shows the Electric Construction Co. alternator which is driven by a Bristol Siddeley "free power gas turbine" Proteus engine. Advantages of the equipment include low capital cost, fully automatic operation with remote control for starting and shutting down, instant readiness at all times (equivalent to spinning reserve) and high reliability, coupled with the fact that the unit is compact, entirely self-contained and requires no cooling water supply.



*E.C.C. alternator driven by a Bristol Siddeley Proteus engine*

## Electrical Industry Production and Investment

DURING 1960 sales and work done by the electrical engineering industry were valued at £1,561·9 million, an increase of 14 per cent on 1959. Sales and work done by all manufacturing industry were valued at £24,551 million, an increase of 10 per cent.

Stocks and work in progress in the electrical industry rose by £80·4 million or over 15 per cent and capital expenditure went up steeply from £57·3 million in 1959 to £67·1 million last year. Of this, £45·3 million was accounted for by new plant and machinery and £18·6 million by new building work. These figures are taken from an article on the 1960 sample Census of Production in the *Board of Trade Journal* for 15th December.

## FERRANTI-ARON AGREEMENT

LAST October it was announced that Ferranti, Ltd., were to purchase the Aron electricity meter business, including manufacturing tools and equipment, for £400,000. At the same time Aron agreed to change their name to Astaron Electronics, Ltd., thereby releasing the name of Aron Meters, Ltd., for use by a new Ferranti subsidiary. To mark the successful implementation of the agreement, directors of both companies met for formal discussions at the Hyde Park Hotel, London, last week.

*Standing (left to right): Messrs. H. L. Aldridge (secretary, Astaron Electronics), J. Prince (director, Ferranti), A. H. Young (director, Astaron Electronics), B. Z. de Ferranti, M.P. (director, Ferranti), H. R. Whitfield (managing director, Astaron Electronics) and O. M. Robson (director, Ferranti). Seated: Messrs. J. H. Thomson (director, Ferranti), Sir Edward Herbert (chairman, Astaron Electronics), S. Z. de Ferranti (managing director, Ferranti), R. D. Poore (director, Astaron Electronics) and F. Rostron (director, Ferranti)*

## G.E.C. Export Drive

A new export drive is being planned by the General Electric Co., Ltd., which has appointed Mr. W. S. H. Whitehead, former export manager of Morphy-Richards, to organise a new attack on the export market for domestic equipment—from refrigerators, cookers and washing machines to irons and hair dryers. Its task is to "build up and strengthen the export organisation of G.E.C. (Domestic Equipment), Ltd., both to maintain and increase the business in the company's existing overseas markets and to extend it into Europe and elsewhere."

Mr. Whitehead spent many years with Morphy-Richards and has travelled in most of the world markets. At the G.E.C. he joins Mr. D. A. Reader, formerly home marketing director of Morphy-Richards, and Mr. Charles Richards, joint managing director of Morphy-Richards, who was responsible for that company's sales efforts.

## TANGENTIAL FAN DEVELOPMENTS

The world-wide rights for the Firth Cleveland Laing tangential fan have been acquired by the Firth Cleveland Group. Plans are already well advanced for setting up an international subsidiary company to exploit these rights on a licensing basis, and when formed, the new company will take over existing licences previously issued in Germany. So far, the main demand has been for the electric fan heater, but this has since been extended to include clothes dryers, table fans, extraction fans, storage heaters, hair dryers, etc.

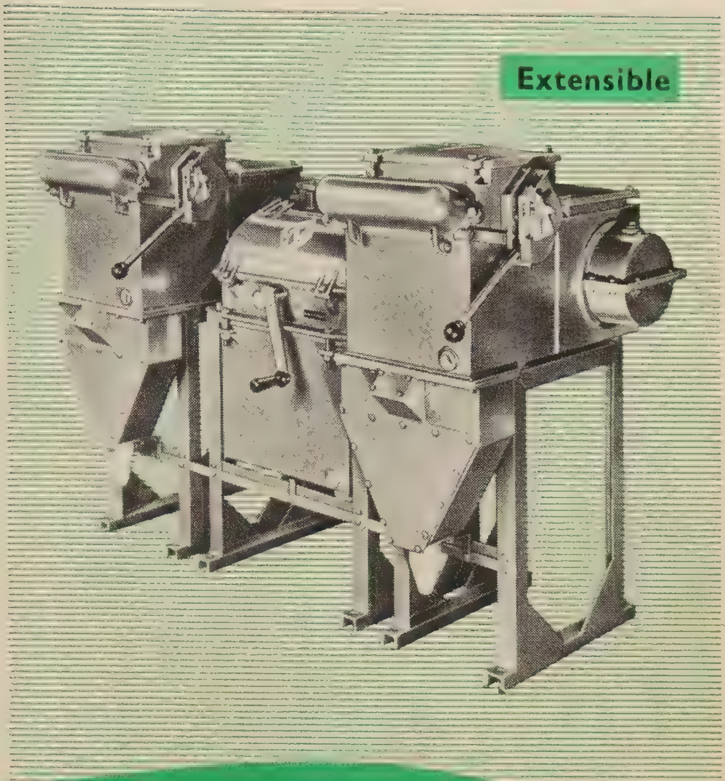
# RING MAIN TEE-OFF

**Rupturing capacity 250 MVA ASTA. Tested at both 6.6. and 11 kV with fault making load breaking Isolators.**

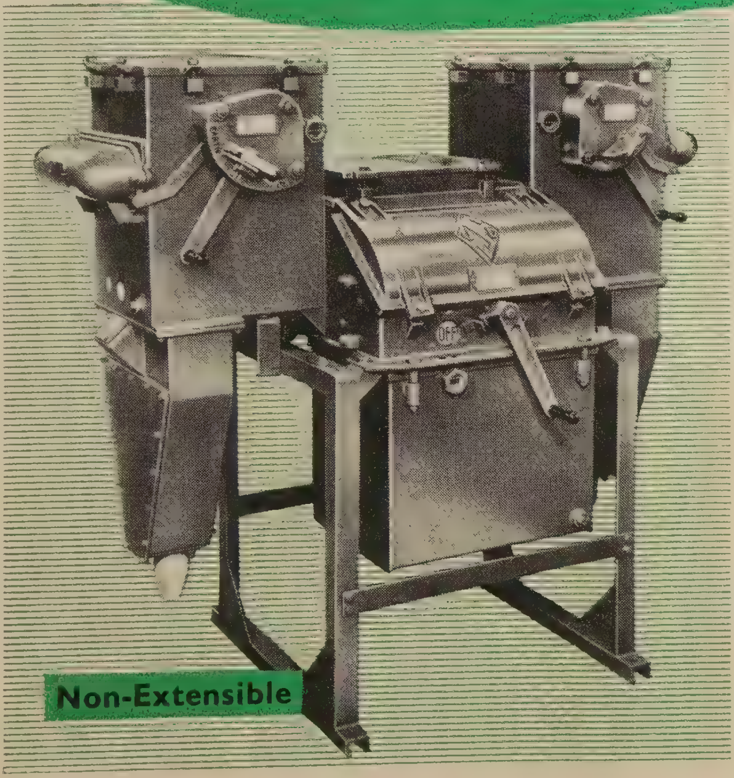
*Impulse tested*

**Rust proof finish if required for outdoor installation.**

*Many different arrangements available including transformer mounting and for incorporation in switchboards with Oil Circuit Breaker Units.*



# H.V. FUSE SWITCH EQUIPMENT



*The following can be fitted if required:*

**Spare fuse container. Ammeter. Potential indicator. Shunt trip. Earth Leakage trip. Earthing and/or testing device for Fuse Switch. Metering Unit with Voltage and current transformers.**

*Leaflets Nos. 555 and 556 available to bona-fide applicants.*

*Switchgear by*
STATTER

***Specialists in Switchgear for over 50 Years***

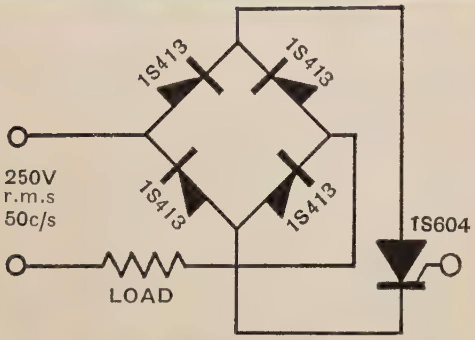
## J. G. STATTER & CO. LTD.

Telephone: LITTLE CHALFONT 2671/6 AMERSHAM COMMON, BUCKS, Telegrams: STATTER AMERSHAM

A MEMBER OF THE MI METAL INDUSTRIES GROUP

# THIS A.C. PHASE CONTROLLED SWITCH NEEDS ONLY ONE S.C.R. TO HANDLE FULL 850W LOAD

# TEXAS SILICON CONTROLLED RECTIFIERS HIGHER EFFICIENCY REDUCES COSTS



ACTUAL SIZE

The circuit shown requires only one silicon controlled rectifier, thus reducing costs in many applications. A.C. mains voltage is applied to a bridge rectifier in series with the load. The current is controlled by operating the silicon controlled rectifier, which is placed across the bridge, as a switch. The S.C.R. is fired by a pulse generator which can be based upon a complementary bistable circuit using Texas 2S301 and 2S701 silicon industrial transistors.

| Type | Description | Peak Inverse Voltage and Forward Breakover @ 125°C* P.I.V (V) | Max. Mean D.C. Forward Current | | Max. Gate Current required to turn device on $I_{GF}$ (mA) | Max. Sustaining Current $I_H$ (mA) |
|---|---|---|---|---|---|---|
| | | | @ 65°C* $I_o$ (A) | @ 125°C* $I_o$ (A) | | |
| 1S600<br>1S601<br>1S602<br>1S603<br>1S604 | Stud mounted device with an extremely small gating power requirement | 50<br>100<br>200<br>300<br>400 | 3 | 1 | 20 | 25 |
| 1S610<br>1S611<br>1S612<br>1S613<br>1S614 | Mounted in a standard TO-5 transistor case and having a 1A rating | 50<br>100<br>200<br>300<br>400 | 1 | 0·3 | 20 | 25 |

*Stud or case temperature.

**THYRATRON ADVANTAGES WITH SEMICONDUCTOR RELIABILITY**

**PRODUCED BY TEXAS FOR INDUSTRY**

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# Pattern of Industrial Research

THE main limitation on the expansion of research and development activity in Britain is lack of qualified manpower. This is one of the findings of what is claimed to be the first investigation to attempt a qualitative as well as a quantitative analysis of research and development in British manufacturing industry. It was carried out by the Federation of British Industries in conjunction with the National Institute of Economic and Social Research.

The report of the investigation,* published last week, says that there is a standing vacancy rate of about 13 per cent overall in industry's research and development departments and "there is no doubt that a substantial number of research projects are held up for lack of staff." A large proportion of firms would expand their present research activity were adequate resources available. In electrical engineering the number of vacancies, expressed as a percentage of qualified scientists and engineers already employed on research and development, was 11·88 per cent for large firms and 37·5 per cent for small firms. In large specialised electronic firms the figure was 24·65 per cent.

The investigation has also shown that as much expenditure is being devoted to basic research and new products as to improvements in existing products and services. In the electrical firms analysed 9·42 per cent of the total research and development effort was basic research, 10·03 per cent related to minor improvements, 11·84 per cent to major improvements, 42·24 per cent to new products and 22·35 per cent to technical services. Only 9·75 per cent of the work failed to contribute to a product in commercial use. Ten out of the 17 electrical firms questioned had plans for expanding their research and development effort. Excluding aircraft, the number of qualified scientists and engineers employed on Government work is substantial only in electrical engineering, where it amounts to about 30 per cent.

The investigation reveals some interesting information on research associations. In the electrical industry these account for only 1 per cent of the industry's total research and development expenditure, and 13 electrical firms out of the 34 respondents did not belong to a research association. The view held by large firms that research associations are mainly of value to the smaller firms did not find support in any replies from the medium-sized or small firms. Although the survey shows there is a demand for improvements in the external research facilities in engineering there is no demand for an increase in the number of research associations or of sponsored research institutes.

A disturbing feature of the report is the lack of interest it reveals in research economics and the fact that few firms have well-established and sound procedures for choosing and reviewing research and development projects.

Total employment in research and development departments is estimated at 120,000. Of the total employed some 28,600 are qualified scientists and engineers and on average £8,750 is expended per qualified man per annum, giving a total outlay of £250 million excluding capital expenditure. Expenditure in the electrical industry is estimated at £55,230,000 and with 8,037 qualified men the average expenditure per man is £6,872. Chemicals and electrical engineering employ some 60 per cent of all the qualified men in research and development although their total employment is only 25 per cent of that of F.B.I. membership as a whole. Over 90 per cent of research activity is carried out by firms employing 2,000 people and over.

Allowing for the differences in industrial output and the cost of research in the two countries, the survey shows that the level of research in Britain compares favourably with that of the United States.

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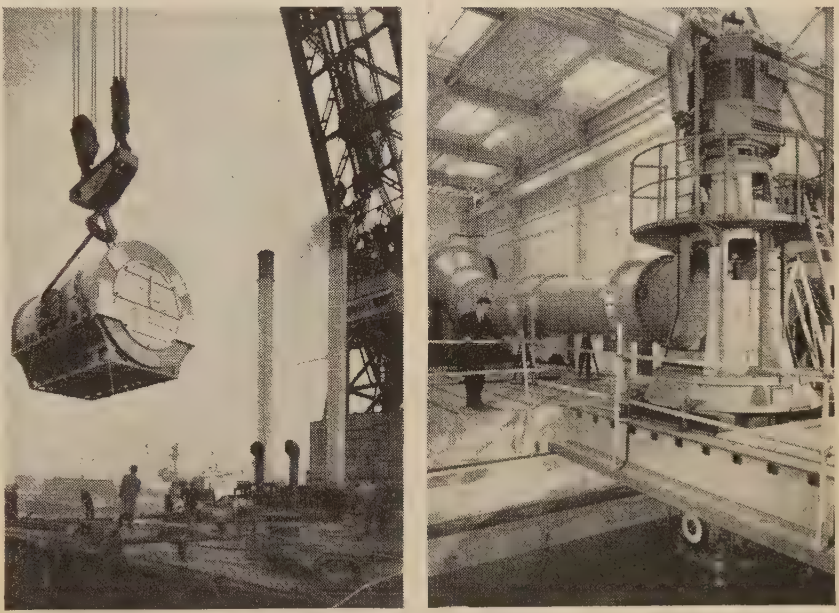
* "Industrial Research in Manufacturing Industry 1959/60." F.B.I.

## *Plant for Canadian Power Station*



*The stator of a 150 MW A.E.I. turbo-generator for Wabamun power station being shipped at Liverpool and (right) a c.w. pump for the set undergoing tests at the works of W. H. Allen, Sons & Co., Ltd.*

THE Wabamun power station of Calgary Power, Ltd., in Alberta, is being extended by the addition of a 150 MW turbo-alternator ordered from Associated Electrical Industries, Ltd., who also supplied the two 66 MW sets already installed. In the accompanying photograph (left) the generator stator is shown being shipped aboard the s.s. *Andria* at Liverpool en route for Sorel on the St. Lawrence. Wabamun is about 50 miles north of Edmonton and at one point on the railway it has been necessary to remove an outcrop of rock to allow the stator to pass.

The right-hand picture shows the second of two large pump sets which will supply circulating water for the set undergoing tests at the Bedford works of W. H. Allen, Sons & Co., Ltd. The first pump has already been shipped to Canada. Each unit comprises a 48in suspended "Allen-Stork" mixed-flow condenser circulating-water pump and is rated at 37,800 gal/min against a total head of 35·6ft. They are driven by 500 h.p. A.E.I. squirrel-cage, drip-proof, 60 c/s motors. Four 33in suspended "Allen-Stork" mixed-flow circulating-water pumps are in service at the Wabamun steam plant under an earlier contract.

# Aluminium Foil in Telecommunication Cables

WHEN the experimental lengths of "Cantat," the Anglo-Canadian transatlantic telephone cable, were made by Submarine Cables, Ltd., it was found necessary to include a thin aluminium foil screen to improve attenuation measurements. The same system will be used in "Compac," the 8,000-mile Commonwealth Pacific telephone cable linking Canada and Australia.

These lightweight telephone cables have an inner conductor which consists of a thin longitudinal copper tape, box-seamed tightly on to a steel strand—the latter providing the strength to withstand laying and recovery tensions. Polythene insulation is extruded on to the conductor and a coaxial return conductor of aluminium tapes is then applied helically.

In the early design these tapes were held in position by a cotton tape impregnated with barium chromate as a corrosion inhibitor. It was found, however, that with this simple construction the crosstalk between the repeater-section lengths of cable, when coiled in the ship's tanks, could modify the repeater gain, thus preventing accurate measurement of attenuation. Consequently, an overlapped aluminium foil screening tape 0·004in thick, supplied by Aluminium Foils, Ltd., was added.

To avoid electrical instability due to random contact between the two layers of aluminium tape, they are separated by a polythene tape and a second polythene tape is interleaved with the screening tape. The impregnated cotton tape is then applied over the screening tape assembly and the whole cable encased in a polythene extrusion.

### Large Instrumentation Order

George Kent, Ltd., are to supply instrumentation and fully automatic control equipment worth over half a million pounds to be installed at the new Drakelow "C" power station.

## *CLEAN AIR EQUIPMENT*

TWO orders covering the supply and commissioning of forty flue dust monitors have been placed with the Electronic Apparatus Division of Associated Electrical Industries, Ltd., by Babcock & Wilcox, Ltd. The equipments are to be installed at C.E.G.B. generating stations at West Thurrock and Rugeley—twenty at each site.

A dust monitor head will be installed in each induced-draught inlet duct and will, without change in velocity, measure the dust emission from the dust arresting plant before it enters the main duct and chimney stack. When the dust emitted exceeds the accepted level as determined by the Alkali Inspectorate, a warning device fitted to the equipment will operate a flashing light on the boiler control desk so that the operator can take the necessary action.

A continuous recording of the dust emission will be provided during the operational period of each boiler. The time between cleaning can be as long as, or even longer than, 15 months. Similar installations have already been put in hand at Blyth "B" station.

### COMPRESSORS FOR POLAND

A contract for axial flow compressors to supply compressed air for a large tonnage oxygen plant in Poland has been awarded to Hawker Siddeley Brush Turbines, Ltd., by Constructors John Brown, Ltd. The compressors will be electrically driven (approximately 6,000 h.p.). The machines are the first of their type to be manufactured in this country and the first to be supplied by a British company for use in a tonnage oxygen plant. Constructors John Brown are working in association with Hydrocarbon Research, Inc., of America, who are supplying the process techniques for the plant.

### Sunbeam Electric Acquisition

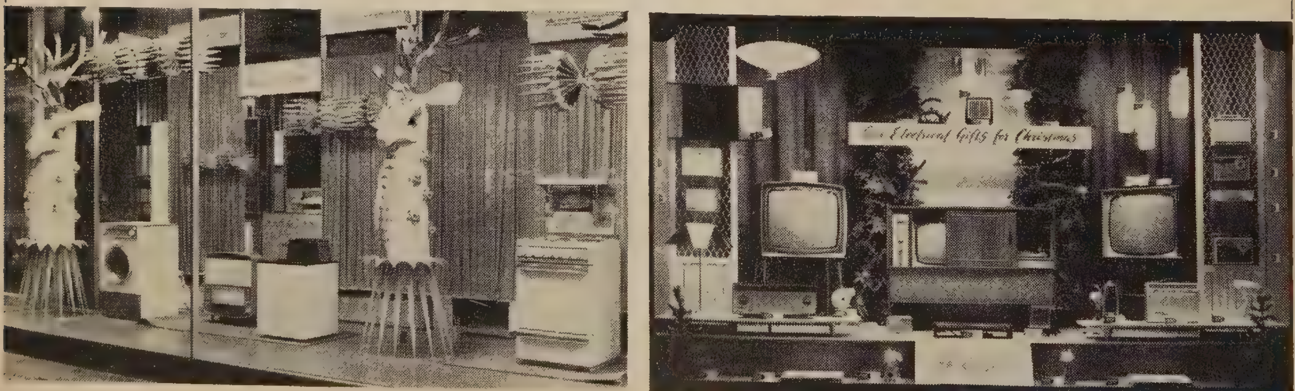
The Lawn Care and Agricultural Equipment Division of the Cooper-Stewart Engineering Co., Ltd., has been acquired by Sunbeam Electric, Ltd. This Division makes lawn sprinklers, electric fencers, hedge trimmers and animal clipping equipment. Manufacture will shortly be transferred from Letchworth to East Kilbride.

The Cooper-Stewart Engineering Co., Ltd., is now devoting the whole of its factory at Letchworth to the manufacture of compressors and exhausters and the company will in future trade under the name of Cooper Compressors, Ltd.

### Abattoir Electrical Installation

Jardine & Smith (Electrical Engineers), Ltd., have been awarded the contract for the electrical installation in the new city abattoir at Manchester. The value of the contract exceeds £94,000.

## Christmas Window Displays



*Left: Vulcanised fibre, wire, paper and ornaments have been skilfully used by Stanislaw Niczewski, the industrial designer, to produce seasonal effects in the window display at the Radiation Domestic Appliance Centre in Baker Street, London. Right: The colourful Christmas display at the headquarters of the General Electric Co., Ltd., will be the last at Magnet House. A wide choice of electrical gifts is shown, including for the first time those bearing the Sobell and McMichael trade names*

# TRADE ANNOUNCEMENTS

IT IS announced that **Wandleside Cable Works, Ltd.,** and its associates, Wandleside Warren Wire Co., Ltd., and Irish Cables, Ltd., both of Northern Ireland, are to work in close collaboration with **Continental Electroindustrie Akt.-Ges. (Kabelwerk Vohwinkel),** which has cable works at Wuppertal, Wipperfürth and Bremen.

When Venesta Foils, Ltd., was acquired from Venesta, Ltd., by Reynolds T.I. Aluminium, Ltd., it was agreed that the use of the name "Venesta" in connection with the aluminium foil business should eventually cease. It has now been decided to operate the United Kingdom and Indian branches of the business by separate companies, and the name of the company to which the United Kingdom business and factories are being transferred is **Aluminium Foils, Ltd.** The registered and head offices will be the same as those of Venesta Foils, Ltd. (Thorn House, Upper St. Martin's Lane, London, W.C.2).

The Pollard Ball & Roller Bearing Co., Ltd., announces the formation of the **Pollard Ball & Roller Bearing Corporation,** with offices at 521, Fifth Avenue, New York, 17. This development gives the Pollard organisation, with its Canadian subsidiary, facilities for further extending the company's ball and roller bearing business throughout North America. Mr. J. L. King, chairman of the Pollard Ball & Roller Bearing Co., is president of the corporation. The resident director is Mr. F. W. Herlitz, director of the Western Steel International Corporation in New York.

**Radiation, Ltd.,** is to acquire the domestic appliance interests in Australia of Coates & Co., Ltd., and its subsidiary, Radcoates (Pty.), Ltd., subject to the approval of the shareholders of Coates & Co.

The Radiation Group business in Australia has formerly been carried on partly through an agency and manufacturing agreement with Coates & Co. and partly through a wholly-owned subsidiary, Parnall (Australia), Pty., Ltd.

The **Agron Manufacturing Co., Ltd.,** have been appointed agents of G. Rau, Pforzheim, West Germany, manufacturers of contacts of all kinds, thermobimetals, precision tubes, silver solder, and plated sheets, wires and tubes.

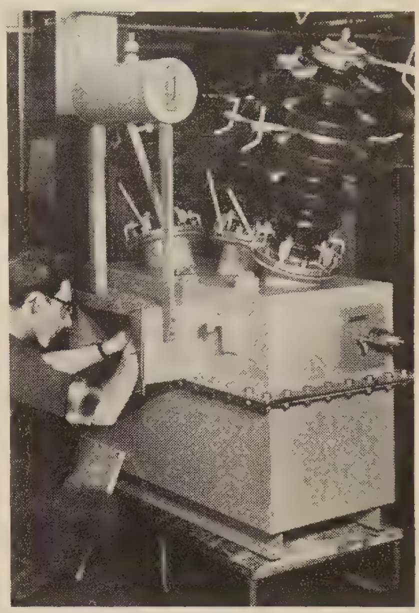
**Lansing Bagnall, Ltd.,** manufacturers of battery electric fork lift trucks and industrial tractors, have formed a new company, Lansing Bagnall International, to co-ordinate all European trading and the work of Lansing Bagnall A.G., of Zurich. The new company will be based at Glarus, Switzerland.

The Southern Area office of **Fielden Electronics, Ltd.,** has been moved to larger premises at 181-183, Earls Court Road, London, S.W.5 (telephone: Freemantle 7866).

## SUBSTATION SWITCHGEAR CONTRACT

An order worth approximately £250,000 has been placed with the Switchgear Division of Associated Electrical Industries, Ltd., in connection with a new 275/33 kV substation at Aldwarke in the C.E.G.B. North Eastern Region. Included in the contract are three 275 kV, 15,000 MVA lenticular tank oil circuit-breakers. The substation will provide an increased supply to the Park Gate Iron and Steelworks, Rotherham.

## TRANSFORMERS FOR TANGANYIKA



*Final assembly work on one of eighteen 33 kV outdoor-type voltage transformers which have been ordered from Foster Transformers, Ltd., for export to Tanganyika. The order was placed through Balfour Beatty & Co.*

## *RHEOSTATIC EXPANSION*

THE Rheostatic Co., Ltd., manufacturers of "Satchwell" automatic controls and a member of the Elliott-Automation Group, announce that in 1962 a start will be made on the building of a £500,000 factory in the new town of East Kilbride, near Glasgow. With an area of 200,000 sq ft, this factory will eventually be a completely self-contained manufacturing unit, and by the end of the year it is envisaged that some of the Satchwell production at present carried out at Frimley will be transferred to the East Kilbride factory. The space released at Frimley will be used for further expansion of Elliott Bros. (London), Ltd., in certain specialised fields.

The rearrangement of the group's production plans in this way will allow some rationalisation of the Rheostatic Co.'s four factories and this will further permit the increased production which will be required.

## Calendars and Diaries

"OUR HERITAGE" is the title of the attractive wall calendar received from C. A. Parsons & Co., Ltd. Each monthly sheet includes a coloured view of a typical British scene.

Beauty spots in Britain have also been chosen for the 1962 calendar of Hawker Siddeley Industries, Ltd.

A useful wall calendar on stout cardboard with a "Boldefigger" daily pad has been sent by Lindsay & Williams, Ltd., makers of "Megohmoid" products.

The scenes depicted on the C.I.B.A. calendar are from the Rhineland and the descriptive matter is given in five languages.

Striking coloured views of Swiss mountain scenery appear on each page of the calendar received from Brown Boveri.

The desk calendar sent by Bill Switchgear, Ltd., has daily slips each bearing a quotation.

"London Scenes" is the title of the Vactric Engineering calendar for 1962, each two-monthly sheet of which bears a reproduction of an early nineteenth century print by Thomas H. Shepherd.

On the reverse side of each monthly slip of the desk calendar received from Brook Motors, Ltd., appears an illustration of a steam locomotive, from the 1829 "Rocket" onwards.

The diary received from Marconi Instruments, Ltd., contains useful data and maps of England and the world.

The 1962 diary of Tube Investments, Ltd., is bound in soft leather and again includes information on international air lines and London hotels, theatres and clubs.

# NEW ELECTRICAL EQUIPMENT

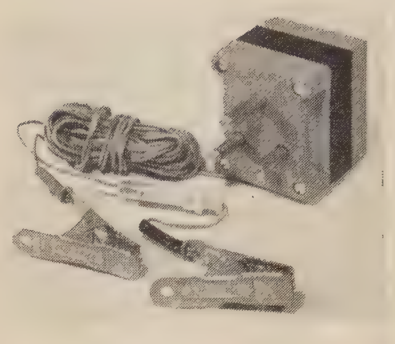
## BATTERY CHARGER PLUG

The "Andec" battery charger plug made by **ANDEC, LTD.**, Bennet Road, Reading, Berks., provides a 1 A d.c. charge for 6 or 12 V batteries from a 230/250 a.c. mains supply. Basically the unit consists of a transformer and rectifier housed within a plug measuring 2in by 2¼in by 2¾in. Blue-grey "Polypropylene" is used for the body moulding. Hermetically sealed silicon diodes of "computer" quality are employed in the bi-phase rectifying circuit.

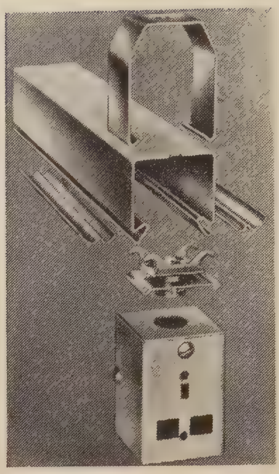
Three types are at present in production, two of which cater for 3-pin 15 A and 3-pin 13 A outlets. The third type is devoid of pins and has a short length of mains cable permanently attached, the free end being available for fitting any suitable mains plug. All are available for charging either 6 or 12 V batteries. An adaptor is also available to convert any 12 V charger to 6 V operation.

An ingenious form of current metering is provided by a "festoon" filament lamp connected in series with the negative output lead which also acts as an output fuse. Variation of light output gives a direct indication of the magnitude of charging current flowing. This, in turn, shows the state of the battery. Under typical conditions of charging a "run down" battery, the initial light output of the lamp would be high, falling steadily to near extinction when the battery was fully charged. Should an internal fault occur, a primary cartridge fuse rated at 1 A will protect the unit from serious damage.

The price of the unit (all types) is £1 19s 6d complete with 8ft leads, battery clips, etc.



*"Andec" CP 12/15 charger plug for use from a 15 A socket outlet*

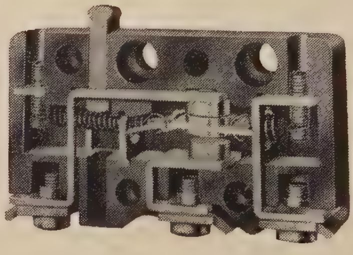


*Power Centre "Hi-duct" suspension trunking*

## DECORATIVE LAMP

The incandescent lamp that won the grand prix at the 1960 Milan Triennale for Finnish designer Tapio Wirkkala is to be marketed in the United Kingdom. Made by Airam AB, of Helsinki, the lamp has a decorative shape and can be used without a shade. It is comparatively large in relation to the wattage, and the light from the filament is evenly dispersed through the surface by a layer of powder composed of silica and titanium oxide. The lamp is available in two shapes, WIR 105 and WIR 85, each in 40 and 60 W sizes at 240 V and with bayonet or screw fittings. The WIR 105 lamp is diamond shaped and is 5½in long, the WIR 85 being slimmer and 8¼in long. The lamp has an average life of 1,500 hr and can be obtained in four colours—white, red, yellow and blue. The filament is a normal single spiral and the gas filling is a mixture of argon and nitrogen.

The price of the white lamp is 12s 6d including purchase tax. The United Kingdom importer and distributor is A. A. **KALEV**, 38, Endlebury Road, London, E.4.



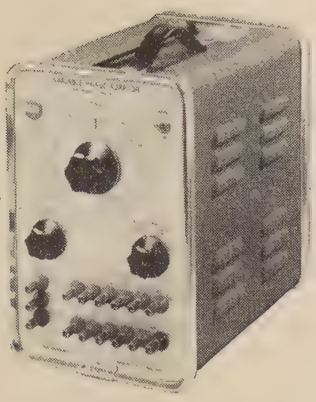
*Chilton double-action micro-switch*
*Left : Wirkkala decorative lamps*

## DOUBLE-ACTION MICRO-SWITCH

The M.S. 10 double-action micro-switch now being marketed by **CHILTON ELECTRIC PRODUCTS, LTD.**, Hungerford, Berks., has been designed to ensure rapid contact separation. Any unstable condition is limited to a detached actuating fork and is not transmitted to the contacts. The operating plunger starts the first snap action of the actuating fork, which changes its position rapidly, knocking in free movement on to the contact carrier which in turn snaps over to the opposite contact. The actual contact pressure is generated by a second spring—pulling up or down on the contact carrier—and is thus maintained at a constant level, independently of the position of the operating plunger. Contact pressure is further reinforced by the pressure of the actuating fork and its spring, which renders the switch immune to shock and vibration.

## TRUNKING SYSTEM

A suspension trunking system has been introduced by the **POWER CENTRE CO., LTD.**, Wednesbury, Staffs., under the name of "Hi-duct." It is sufficiently rigid for only infrequent suspensions to be needed. Outlets can be fixed at any point. There is a wide range of accessories including cover sections, couplings, suspension



*Dawe variable phase adaptor*

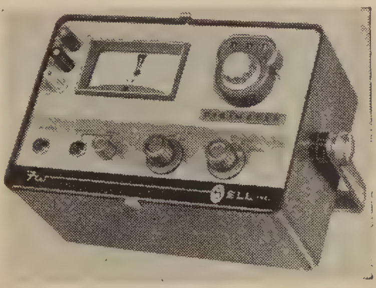
brackets, hanger clips, etc. These accessories and standard fittings are fixed to the trunking without cutting or drilling and without impeding the removal of cover sections.

The trunking is made of 18 s.w.g. galvanised steel with a cover section of 24 s.w.g. material. It is supplied in 12ft lengths complete with couplings, and the cover sections are in 6ft lengths. Fastening of the cover section to the trunking is achieved by a spring action. A friction coupling provides a joint between trunking lengths, and complete earth continuity.

## MEASURING INSTRUMENT

Direct current voltage and resistance values can be measured to an accuracy of ±0·1 per cent of full scale with the F. W. Bell Model 61 "Digimeter," available in this country through Livingston Laboratories, Ltd., 31, Camden Road, London, N.W.1. Voltage measurements over five ranges from 0 to 100 mV to 0 to 1,000 V are made by backing the unknown against a comparison voltage whose value is shown on a three-digit dial system. This voltage uses a Weston cell as a reference and null indication is given by a front panel meter.

For resistance measurements the "Digimeter" is operated as a precision Wheatstone bridge and covers from 0 to 100 Ω to 0 to 1 MΩ with a resolution of ±0·1 per cent on all ranges except the top. The instrument is supplied from self-contained batteries, making it portable, and it has an output for meter or recorder calibration.



*Bell "Digimeter" available from Livingston Laboratories, Ltd.*

*Oryx soldering tweezers*

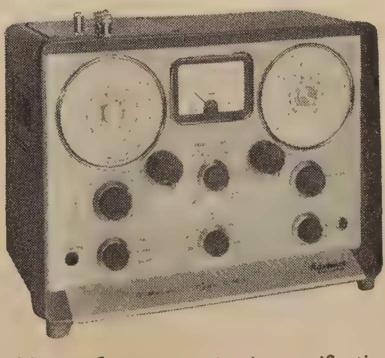
## MINIATURE SOLDERING TWEEZERS

A soldering instrument has been developed for precision soldering in laboratories and on production lines with micro-miniature circuit modules, diodes, transistors, other semiconductors, relays, etc., by Oryx Electrical Laboratories, Ltd. The instrument is in the form of a pair of tweezers having $\frac{1}{32}$ in tips with a separate heating element in each tip. The elements operate at up to 554°F tip temperature from a 6 V supply. These soldering tweezers are marketed in the United Kingdom by W. Greenwood Electronic, Ltd., 677, Finchley Road, London, N.W.2.

## CIRCUIT MAGNIFICATION METER

Continuous measurement is one of the features of the circuit magnification meter, the C.M.1, produced by Advance Components, Ltd., Roebuck Road, Hainault, Essex. It is designed for measurements of circuit magnification (Q), inductance and capacitance over a frequency range of 100 kc/s to 100 Mc/s. The internal carrier level is stabilised so that during the course of measurement the signal level does not have to be reset. For capacity measurement the normal ranges are 10-70 $\mu\mu$F (±1 $\mu\mu$F) and 40-600 $\mu\mu$F (±2 per cent).

The instrument also has a specially low capacity range on the internal standard of 10 to 70 pF and facilities are provided for the comparison of the Q of coils over the range ±10 per cent, which makes it suitable for batch testing. A socket is provided for the use of an external Q indicating meter of 100 $\mu$A full scale deflection. A "Voltstat" constant voltage transformer eliminates errors that might arise from supply voltage fluctuations and improves the overall stability of the instrument.



*Advance Components circuit magnification meter*

## VARIABLE PHASE ADAPTOR

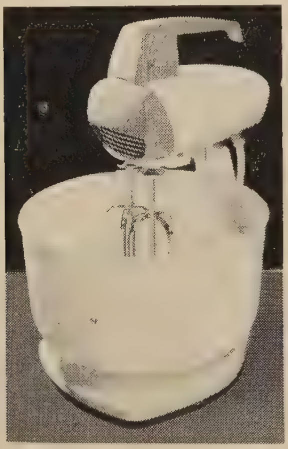
A range from d.c. to 10 kc/s and balanced 3, 4, 6 and 8-phase outputs as well as a steplessly variable 0-360° phase is offered by the Type 446 variable phase adaptor made by Dawe Instruments, Ltd., Western Avenue, Acton, London, W.3. The instrument accepts any quadrature signals up to 5 V r.m.s., two input terminals for 0° and 90° phase being provided. Eight d.c. coupled phase invertors feed a steplessly variable potentiometer providing balanced output signals at eight symmetrically spaced terminals. The 180° and +90° signals are obtained by phase inversion of the inputs. Symmetrical cross-coupling between each pair of phases provides the four intermediate phases. The six-phase output is derived from a symmetrical phase division of the four-phase output.

The variable phase output is adjustable against a dial with linear calibration in 360°, with an accuracy of ±2 per cent. Minimum load resistance is 20 kΩ. Accuracy of the multiphase outputs is ±1 per cent. Equality of amplitudes is pre-set and maintained to within less than 1 per cent for normal mains voltage variation. Minimum load resistance is 2 kΩ. If the instrument is used with accurate oscillators, distortion is less than 1 per cent. Power consumption is about 100 W. The instrument, measuring $8\frac{1}{4}$ by 13 by $12\frac{1}{2}$in high and weighing 18 lb, costs £160.

### FOOD MIXER

A medium sized electric food mixer, the "Burcomix," is now being marketed by **BURCO, LTD.**, Burnley, Lancs. It is fitted with a universal, series wound, three-speed motor claimed to give average no-load speeds of 750, 600 and 450 r.p.m. respectively. A single-pole switch combines the functions of on/off switch and speed control. The body and handle of the mixer are made of "Cycolac," a non-toxic plastic material, and the gears are moulded in nylon. The stand, from which the mixer is detachable for use as a portable machine, is made from a "Mazak" die-casting and rests on four rubber feet. To aid mixing, the stand has a revolving base. The beaters are of chromium plated steel and the bowl is made of heat resistant glass.

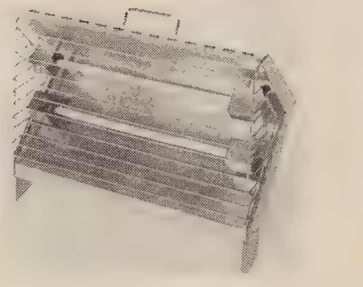
The mixer, complete on stand with bowl, is $11\frac{1}{4}$in high by 10in wide by $8\frac{1}{2}$in deep and weighs $9\frac{3}{4}$ lb. The mixer only, with beaters, weighs about $3\frac{3}{4}$ lb. The finish is white and blue and the price is £13 13s 9d, including purchase tax, complete with bowl and stand. A wall storage hook is also available price 2s 6d.



*"Burcomix" electric food mixer (Burco, Ltd.)*

### INFRA-RED HEATER

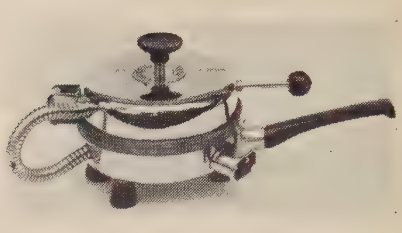
The new "Como" infra-red heater now being marketed by **R. S. STOKVIS & SONS, LTD.**, 12/16, High Street, Walton-on-Thames, Surrey, is fitted with two 1 kW quartz elements, each operated individually by press-button switches. For added convected heat a channel round the back of the reflector has top and bottom louvres. The heater, which is designed as a floor model, weighs $9\frac{1}{2}$ lb and measures 19in by $14\frac{1}{2}$in by 9in. The finish is in blue and citron and the price, including purchase tax, is £10 10s 8d.



*"Como" 2 kW infra-red heater (R. S. Stokvis & Sons, Ltd.)*

### TABLE GRILL

The latest item to be introduced by the **INFRA-HEAT CO., LTD.**, 22, Clifton Road, London, W.9, is the "Minigrill," a multi-purpose electric contact grill only 6in in diameter. Both the top and bottom plates of the grill are heated (total loading 600 W); thus it can be used in either the open or closed positions. The pre-heating time is only 4 minutes and normal cooking times are stated to be 1 minute for steaks, 15 seconds for bacon and $1\frac{1}{2}$ to $2\frac{1}{2}$ minutes for fish. The top plate is self-adjusting, enabling food up to 1in in thickness to be cooked. It has a highly polished outer casing and is fitted with a heat-proof manipulating handle. The total weight of the appliance is $6\frac{3}{4}$ lb and the price is £5 12s 6d.



*Infra-Heat Co.'s "Minigrill"*

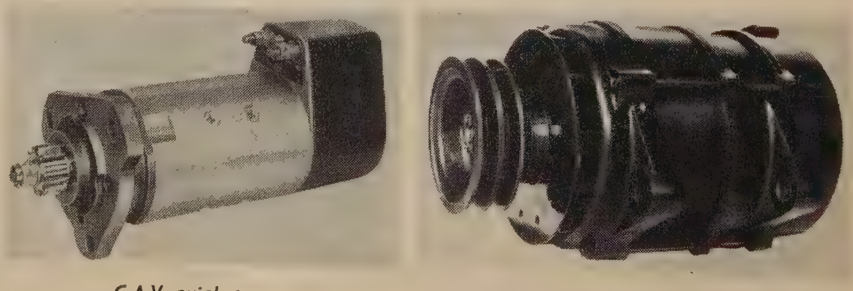
## COMMERCIAL VEHICLE DEVELOPMENTS

TWO items of electrical equipment for commercial vehicles have recently been announced. A 5in diameter axial-type starter for diesel engines produced by C.A.V., Ltd., weighs 17 lb less than a comparable 6in unit. The complete armature assembly and pinion moves forward axially to engage with the engine flywheel gear ring.

Normally, the armature is held in the disengaged position by a spring at the commutator end of the machine, the armature being axially out of register with the pole shoes. The field comprises an auxiliary and main series winding and a shunt winding. When an integral solenoid is energised, its first stage contacts close, bringing the auxiliary series and shunt windings into circuit. These cause the armature to revolve slowly and move forward to register with the pole shoes. As the pinion meshes with the gear ring, a trigger catch projecting from the solenoid is tripped, closing the solenoid second stage contacts and energising the main series winding. The starter can then turn the engine over.

A spring-loaded multi-plate clutch is incorporated to protect the starter in the event of an engine backfire or an excessive starter overload. The pinion is maintained in mesh by "hold on" windings, energised while the push-button is pressed. The nominal rating of this 24 V unit is 6 h.p.

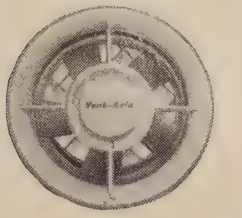
A 24 V, 1,750 W a.c. generator developed by Simms Motor Units, Ltd., incorporates a three-phase star wound stator and a rotor with a single energising coil fed from two slip-rings in the rectifier compartment. Also in this compartment are six silicon diodes, mounted on cooling fins, forming the main three-phase bridge rectifier, and three further diodes which prevent reverse current flowing to the field during shut-down and provide a convenient means for connecting a warning light. The machine weighs 50 lb. The maximum output is at engine idling speed and is 70 A cold or 60 A hot.



*C.A.V. axial starter and Simms a.c. generator for commercial vehicles*

# FOR BETTER AIR CONDITIONS

**WINDOW MODELS**
*in black or ivory*



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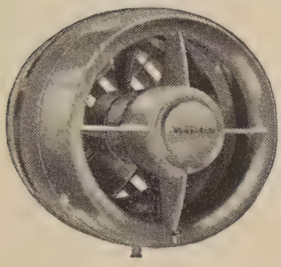
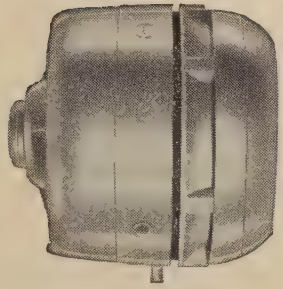


7½″



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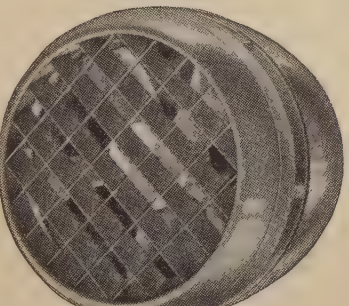


12″

The Vent-Axia range of elegant window and wall models can be equipped with optional fitments to satisfy a wide variety of ventilation requirements.

- ✳ Inbuilt automatic shutter to prevent backdraught.
- ✳ Choice of control: Single Direction (Type SD) or Reversible (Type R), both giving three speeds including boost for extra performance.

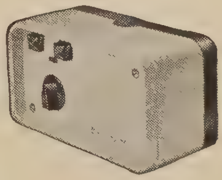
*Here is ventilation, just as you want it, at the turn of a switch.*

**Vent-Axia**

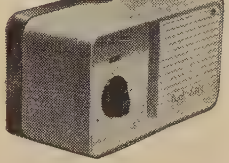
**60 Rochester Row • London SWI**
**Telephone: VICtoria 2244**

BRANCHES AT GLASGOW · MANCHESTER
BIRMINGHAM · LEEDS
NEWCASTLE-UPON-TYNE · BRISTOL

A MEMBER OF THE HALL-THERMOTANK GROUP

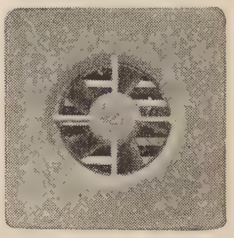


CONTROL SWITCH
TYPE R



CONTROL SWITCH
TYPE SD

**WALL MODELS**
*with ivory fascia*



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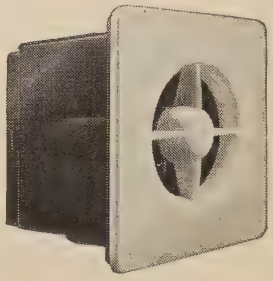

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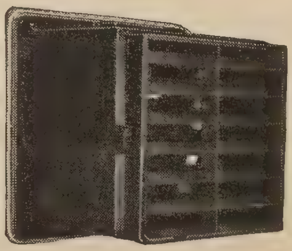

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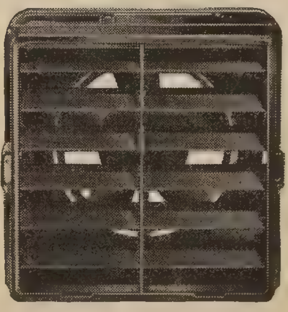

12″

# SPECIFY VENT-AXIA

**DOUBLE SECURITY**

The Members of the
ASSOCIATION OF STEEL CONDUIT MANUFACTURERS are united in their determination to maintain the HIGH AND CONSISTENT QUALITY OF THEIR PRODUCTS.

**THE A.S.C.M. MARK**

is a guarantee of the fulfilment of this intention and also to the fact that A.S.C.M. Conduit conforms to B.S. Specification 31. A.S.C.M. methods of production and the self-imposed high standards achieved ensure just that

**EXTRA SATISFACTION AND SECURITY**

by which Architects and Consulting Engineers can make absolutely sure of the reliability of the electrical installations for which they are responsible.

**SPECIFY A.S.C.M.
AND ENJOY THIS DOUBLE SECURITY**

**A.S.C.M. MEMBERS**

**General Electric Co. Ltd.**
  Incorporating :
    The Oriental Tube Co. Ltd.
**Metallic Seamless Tube Co. Ltd.**
**Monmore Tubes Ltd.**
**Simplex Electric Co. Ltd.**
  Incorporating :
    Credenda Conduits Co. Ltd.
    Simplex Conduits Ltd.
    Stella Conduit Co. Ltd.
**Walsall Conduits Ltd.**
**Electrical Conduits Ltd.**
**Hildick & Hildick**

Association of Steel Conduit Manufacturers, 96 Hagley Road, Birmingham, 16.

## *Financial Section*

# STOCKS and SHARES

STOCK EXCHANGE markets seem likely to end 1961 with activity at an ebb even lower than the seasonal normal, and with industrial share prices at a level some 20 per cent below the peaks established in the early months. Over the whole twelve months, however, the averages are likely to be down by only about 4 per cent, or by less than half the depreciation of the year before. In the face of so many unknown factors in the situation, investment interest may, it is thought, be slow in returning after the holiday, but if buyers are cautious about committing themselves, the behaviour of markets in recent weeks has at least suggested an equal reluctance to be parted from good holdings on present terms.

### E.M.I. Prospects

Sir Joseph Lockwood's review at this month's annual meeting of Electric & Musical Industries was among the more encouraging of recent statements from company chairmen. With the usual reservations, he envisaged an increase in the current year's group sales to the neighbourhood of £90 million, which would represent a 9 per cent expansion on top of the 20 per cent growth recorded in 1960-61. On the subject of profits he was less definite: he expected them to be higher, but hesitated to make a forecast in these times of intense competition. As known previously, the net surplus for the year ended in June, after deduction of increased provisions for depreciation, taxation and interest, came out just about level with that of 1959-60. It gives approximately twofold cover for the unchanged 17½ per cent dividend, on the basis of which the 10s shares at 43s 6d yield 4 per cent.

### Group Interests

Among many points of interest in the E.M.I. chairman's review was the breakdown of the latest turnover figures into their component parts. With the inclusion of amounts for two full years from the relatively new members of the group, Morphy-Richards and Ardente, the rise in turnover between 1959-60 and the last year would have been limited to 2 per cent, this being the net result of improvements of 8 per cent in records and of 13 per cent in electronic capital goods, against an 11 per cent fall in sales of household appliances, radio and television sets, and little change in other products such as magnetic tape and hearing aids. In references to trade in household appliances, Sir Joseph said that as a whole the market had not yet been purged entirely of surplus stocks of refrigerators, washers and similar equipment, but looking ahead he detected reasons for more confidence.

### Eleco Progress

Shareholders of Eleco also heard at the last annual meeting an encouraging review by their chairman about the outlook for the business. He saw the company as being on the threshold of a considerable step forward in activity, leading to increased prosperity. The acquisition of Bell & Webster Industries had greatly improved their competitive powers in the field of street lighting, which had grown to be the major part of the business, and he expected increasingly good results from recent agreements with Philips, Eindhoven, with a view to the sale of some products in all parts of the world. Results for the latest year covered a fifteen-month accounting period, but on an annual basis the dividend is taken as 20 per cent, paid from earnings equivalent to 24 per cent on the ordinary capital of £683,000. At 11s the 2s shares yield just under 3¾ per cent. They have more than doubled in value this year.

### I.C.T. Results

There is no change in the dividend of International Computers & Tabulators at a total of 11¼ per cent, but the rate of progress revealed in the preliminary statement on profits for the year ended in September supported in every respect the status of the company's £1 shares as a leader among the industrial market's "growth" stocks, as expressed in a quotation in the neighbourhood of £5 and a yield no higher than 2¼ per cent. In comparison with last year's figures, the published trading profit is up by 20 per cent at £9·5 million and the net surplus, after the heavy depreciation charges of £5·2 million and other provisions, by 11 per cent at £1·6 million. Since, moreover, it is the company's practice to write off at once much heavy expenditure on training, systems study, etc., the financial benefits of which do not accrue until later years, the figures evidently understate the extent of actual progress. Although the year's retained profits plus depreciation charges (described nowadays as the "cash flow") amount to around £6¾ million, the scale of capital expenditure points to further issues in course of time.

### Falk, Stadelmann

Thanks largely to the company's electrical activities, the improvement in the results reported by Falk, Stadelmann for 1960-61 is being continued into the current year. Sales both for the home and export markets were said at the recent meeting to be showing a satisfactory increase throughout the group. Good progress was mentioned in particular by the sections concerned with lighting, domestic equipment and floor warming: for cables, conditions were still difficult but showed some signs of improvement. Dividends totalling 8¾ per cent go half way towards restoring last year's cut in the rate from 10 to 7½ per cent. The £1 shares have improved to 23s 6d since the appearance of the report and offer a yield of nearly 7½ per cent.

### Preference Shares

With War Loan fairly steady on a yield basis of 6¾ per cent, returns of 7 per cent and over have become common in the lists of industrial preference shares on offer. In the electrical market, English Electric 6½ per cent preference have been available lately at 17s 9d to yield a fraction over 7¼ per cent, and returns of over 7½ per cent have been offered by A.E.I. 4½ per cents at 11s 9d and G.E.C. 7½ per cents at 19s 6d. The 6 per cent issues of B.I.C.C. and Crompton Parkinson have both been quoted around 17s to give a little more than 7 per cent, and E.M.I. 5½ per cents at 14s 9d to pay 7½ per cent on the money.

### Holophane Results

A larger volume of business was handled by Holophane during the year ended last June, but the effect of increased costs of materials and operating expenses left trading profits at very much the same level as for the previous twelve months. The dividend is again being brought up to a total of 30 per cent. This absorbs, as before, the greater part of the disposable surplus of £55,000, and provides a yield of over 9 per cent on the 5s shares at a price of 16s 3d.

Publication of our weekly table of price changes in electrical investments will be resumed in the issue of 5th January

# REPORTS and DIVIDENDS

**Firth Cleveland, Ltd.**—The chairman, Mr. Charles Hayward, in a report to members, says that the group has been affected by the "Little Budget" and its consequences, as well as by strikes among some of the principal customers. With regard to current conditions, he says, results in the retail division are satisfactory. Recent developments have cleared the ground for a closer integration between Broadmead and the rest of the division, and the directors are confident that it will bring substantial rewards in the future.

Negotiations are being concluded for the purchase of a small compact retail group in an area where the group is not strongly represented at present and "valuable manufacturing rights" have been acquired recently for the Engineering Division. The group has also just bought, and is now in a position to exploit, the Firth Cleveland Laing tangential fan patents throughout the world, in addition to the United Kingdom rights. The inventor will be joining the group and will direct some modern laboratories being set up in Germany. Already three-quarters of a million fan components will have been manufactured in Europe this year before the activity has fully started, and the ultimate potential will be considerable. A policy of issuing licences in order to accelerate and maximise the growth of this activity throughout the world with minimum investment will be adopted.

**Radio Rentals, Ltd.**—Group trading profit for the year to 31st August last increased from £5,742,065 to £6,497,337. After increased taxation and depreciation, etc., the profit balance of £1,570,401 is slightly less than last year (£1,573,987). A final dividend of 10½d per 5s share is announced, making a total of 1s 1½d, compared with 1s for 1959-60.

**International Computers & Tabulators, Ltd.**—Pre-tax profits for the year to 27th September, 1961, increased by over £1½ million, from £7,925,000 to £9,506,000. As forecast, the dividend is maintained at 2s 3d per £1 share on capital increased to £12½ million by a one-for-four rights issue. The final dividend is 1s 5d.

It is pointed out that I.C.T.'s rapid growth in the computer and electronic field is involving heavy expenditure on training, systems study, and so on, which, as in the case of research expenditure, is written off at once although the corresponding financial benefit lies entirely in the future. But for this factor, the year's growth in profit would have been materially greater, it is added.

**Duport Profits Down.**—Profits of Duport, Ltd., for the year ended 31st July last amounted to £2,014,991 (before tax of £959,904), compared with £2,614,036 for the previous year, a reduction of nearly 23 per cent. Announcing a final dividend of 5d per share (8⅓ per cent), thus maintaining the total for the year at 8d per share (13⅓ per cent), the chairman, Mr. W. L. Barrows, reports that trading results of the electrical division have improved but are still unsatisfactory. Duport owns the Revo Electric Co., Ltd.

**Philips Incandescent Lamp Works Holding Co.** have announced an interim dividend of 6 per cent, which is equivalent to last year's interim of 5·7 per cent, after allowing for a scrip issue.

**Kerry's (Great Britain), Ltd.,** has acquired the ordinary capital of J. Beaumont & Son, wholesale distributors, for a consideration of 301,710 ordinary 5s shares.

**Siemens & Halske, A.G.**—During the year ended 31st September last, turnover increased by DM.700 million to DM.4,800 million (£429 million) and it is expected to be even higher in the current year. The German members of the Siemens group in 1960-61 invested about DM.400 million more than ever before, but this figure too is expected to be beaten in 1961-62. The directors say that the 1960-61 result is similar to that of the previous year, which makes it appear probable that no increase of the dividend above last year's 16 per cent is intended. The backlog of orders in hand increased further in the last quarter of the year.

**Oldham & Son, Ltd.**—Interim dividend 7½ per cent (the same).

## New Companies

**Peter White (Electrical), Ltd.**—Registered 9th November. Capital £500. Electrical engineers, etc. Directors: P. E. White, Marlene P. White and J. F. Malone (secretary). Regd. office: 27b, Broomfield Road, Chelmsford, Essex.

**Groom's (Electrical), Ltd.**—Registered 17th November. Capital £500. Electrical engineers, etc. Directors: R. Groom and Mrs. Edith Groom. Secretary: A. P. Groom. Regd. office: 14b, Queen Street, Blackpool.

**I. & E. Morton (Electricals), Ltd.**—Registered 6th December. Capital £1,000. Electrical engineers, etc. Directors: E. W. W. Morton and Ann Morton (secretary). Regd. office: 39, Bondgate Without, Alnwick.

**Kenotometer, Ltd.** — Registered 17th November. Capital £1,000. Electronic and automation engineers, etc. Directors: M. H. Martin (secretary), Vivian J. Martin and N. N. Graham. Regd. office: Cheviot View, Newcastle-on-Tyne, 6.

**Prince & Watson, Ltd.**—Registered 17th November. Capital £1,000. Electrical installation contractors, electrical engineers, etc. Directors: B. H. E. Prince and W. G. Watson. Secretary: R. A. Masters. Regd. office: 2, Railway Approach, Wallington, Surrey.

**J. & H. Electrics (South London), Ltd.**—Registered 14th November. Capital £100. Electrical contractors, etc. Permanent director: J. E. Barden. Secretary: Sylvia P. Barden, 17, Howdon Street, London, S.E.15.

**Electron Illuminated Signs, Ltd.**—Registered 14th November. Capital £100. Directors: R. J. Bagnell and B. J. Brundell. Secretary: A. Pursail. Regd. office: 77, Strafford Gates, Potters Bar, Middx.

**Cables & Components, Ltd.**—Registered 14th November. Capital £100. Directors: A. F. C. Harrow and Mrs. Eileen Harrow. Secretary: Shirley Hart. Regd. office: 6, Laurence Pountney Hill, E.C.4.

**John Herbertson, Ltd.**—Registered 28th November. Capital £100. Electrical engineers, etc. Subscribers: Dorothy M. Graeme (secretary) and P. G. Graeme, 61, Fairview Avenue, Gillingham, Kent.

**Albert E. Sara, Ltd.**—Registered 28th November. Capital £10,000. Manufacturers of and dealers in electrical goods, etc. Directors: A. E. Sara and Doreen R. Sara. Secretary: F. H. Eiles. Regd. office: 83/5, St. Mary Road, E.17.

**Temprite, Ltd.**—Registered 23rd November. Capital £2,000. Ventilating, air-conditioning and electrical heating engineers and contractors, etc. Directors: E. C. Lewsey, T. B. H. Brewitt (secretary) and D. G. Brooke. Regd. office: Pelly Works, Pelly Road, Plaistow, E.13.

**Elfido Floor Heating Co., Ltd.**—Registered 24th November. Capital £10,000. Directors: J. F. Thornton and T. Wright. Regd. office: 21, King Street, Liverpool.

**Hudelec, Ltd.**—Registered 24th November. Capital £100. Electricians, etc. Directors: Mrs. Violet D. Young and P. C. Hudson. Secretary: J. A. Wood. Regd. office: 10, Church Path, Woking, Surrey.

**Moores Electrical (Wilmslow), Ltd.**—Registered 27th November. Capital £1,000. Manufacturers of and dealers in electrical appliances, etc. Directors: W. J. Moores and Mrs. Joyce M. A. Moores (secretary). Regd. office: Ship Inn Buildings, Altrincham Road, Styal, Wilmslow, Ches.

**County Electrical Co. (Rugby), Ltd.**—Registered 23rd November. Capital £100. Electrical and general engineers, etc. Directors: Elsie M. Sparks and A. G. Sparks. Secretary: Joan M. Brennan. Regd. office: 121, Railway Terrace, Rugby.

**H. C. D. Research, Ltd.**—Registered 23rd November. Capital £5,000. Electronic, electrical and communication engineers, etc. Directors: Patricia Hooper, C. A. Henn-Collins, O. C. Davenport and F. F. Legg. Solicitors: Longbourne, Stevens & Co., 7, Lincoln's Inn Fields, W.C.2.

**D. H. Carson & Co., Ltd.**—Registered 23rd November. Capital £3,000. Manufacturers of and dealers in electrical goods, etc. Directors: D. H. Carson, Fay Carson (secretary), H. Carson and Estelle Carson. Regd. office: 19/23, Oxford Street, W.1.

**Heco Fluorescent, Ltd.**—Registered 23rd November. Capital £500. Manufacturers of and dealers in lamps, etc. Directors: H. Gehr and Erica Gehr (secretary). Regd. office: 52/4, Gray's Inn Road, W.C.1.

**Milligan Electronics, Ltd.**—Registered 23rd November. Capital £1,000. Subscribers: E. F. W. Batts (permanent director) and A. E. Russell (secretary). Regd. office: 265, Strand, W.C.2.

**Gordon B. Moore (Electrical), Ltd.**—Registered 31st October. Capital £2,500. Manufacturers, exporters, importers, wholesalers, retailers, merchants of and agents for electrical apparatus, etc. Subscribers: G. Moore and B. M. McLernon. First directors: G. Moore, A. V. Sayers and G. H. Jones. Regd. office: 202, Mansfield Road, Nottingham.

**D. Bastie, Ltd.**—Registered 31st October. Capital £100. Electrical engineers and contractors, etc. Subscribers: D. H. Bastie (first director) and Brenda Bastie (secretary). Regd. office: 35, Canterbury Road, Harrow, Middlesex.

**Switchgear Engineering, Ltd.**—Registered 21st November. Capital £40,000. To acquire patents, patent rights and machinery; to carry on the business of engineers and manufacturers of mechanical and electrical apparatus and machinery, etc. Subscribers: A. H. Isaacs and E. H. Harden. Solicitors: Stephenson Harwood & Tatham, Saddlers Hall, Gutter Lane, E.C.2.

**Norman R. Lilly, Ltd.**—Registered 22nd November. Capital £2,000. Electrical engineers, etc. Directors: N. R. Lilly (secretary) and B. G. Wain. Regd. office: 116, Carrfield Avenue, Toton, Notts.

**Midland Colour Television, Ltd.**—Registered 22nd November. Capital £100. Manufacturers of and dealers in radio, television and electrical apparatus, etc. Directors: D. Allen (secretary) and S. Goodall. Regd. office: 255, City Road, Fenton, Stoke-on-Trent.

**Pindus Electric, Ltd.**—Registered 22nd November. Capital £100. Electrical engineers and contractors, etc. Directors: D. Pindus and Mrs. Frances Pindus (secretary). Regd. office: 8a, Russell Parade, Golders Green Road, N.W.11.

**A. & E. Gardiner, Ltd.**—Registered 22nd November. Capital £200. Electrical contractors, radio engineers, etc. Directors: H. A. C. Gardiner and Mrs. Elizabeth E. Gardiner (secretary). Regd. office: 5, Maxwell Road, S.W.6.

**Pringle Products (Electrical), Ltd.**—Registered 6th December. Capital £500. Manufacturers of and dealers in television, radio and electrical components, etc. Secretary: J. D. Berman. Regd. office: 69-71, Praed Street, W.2.

**Bakker Lock Consultants, Ltd.**—Registered 21st November. Capital £100. Electrical engineers, etc. Directors: A. N. Bakker, Patricia A. Bakker, P. J. Lock (secretary) and Maureen P. Lock. Regd. office: 45, Butts Green Road, Hornchurch.

**J. & E. Barrett, Ltd.**—Registered 21st November. Capital £3,000. Television, radio, electrical and electronic engineers, etc. Directors: J. Barrett, Mrs. Bertha Barrett, F. Walsh (secretary) and Mrs. Gladys Walsh. Regd. office: 2, New Wellington Street, Blackburn.

**Stockblock, Ltd.**—Registered 4th December. Capital £100. Electricians, mechanical, radio and general engineers, etc. Directors: M. E. Braynis (secretary) and Jean M. Braynis. Regd. office: 10, Corringham Road, Wembley Park, Middx.

**Brookes Crystals (1961), Ltd.**—Registered 30th November. Capital £100. Manufacturers and repairers of instruments incorporating piezo-electric materials of all kinds, electronic apparatus, dealers in machinery, workers in quartz, glass, minerals and metals, etc. Directors: A. W. C. Gooch, C. P. Millsom, B. W. Brookes and L. A. Housego. Regd. office: Cornhill Factory, Ilminster, Som.

**Willowfield Systems, Ltd.**—Registered 30th November. Capital £1,000. Mechanical and electrical engineers, etc. Directors: F. E. Hupfield (secretary) and Mrs. Emilie E. Hupfield. Regd. office: 7, Staple Inn, W.C.1.

**Howard Bros. (Darlaston), Ltd.**—Registered 1st December. Capital £1,000. Television and electrical engineers, etc. Directors: M. F. Gibbons, C. P. Gibbons, K. J. Howard and F. G. Howard. Secretary: H. W. Pethybridge. Regd. office: 45, Welsh Back, Bristol.

**Markon Engineering Co., Ltd.**—Registered 1st December. Capital £500. Electrical and mechanical engineers, etc. Subscribers: W. H. Kelham and J. P. Hegarty. Solicitors: Kelham & Sons, 49, Broad Street, Stamford, Lincs.

**B. & H. (Heating), Ltd.**—Registered 4th December. Capital £5,000. Heating engineers, etc. Directors: A. R. Brown and C. Haworth. Secretary: Audrey Haworth. Regd. office: 11, Peter Street, Manchester, 2.

## Liquidations

*Winding-up proceedings or liquidations are often undertaken for the purpose of reconstruction, the transfer of a business, or other reasons. The appearance of a company's name under this heading therefore does not necessarily indicate insolvency.*

**Wheatman, Ltd.,** radio, television and electrical equipment dealers, 5, Stoneham Street, Coggeshall, Essex.—Liquidator, Mr. R. A. Hawken, Bank Chambers, 1, John Street, Bedford Row, London, W.C.1, appointed 30th November.

**A. Lace & Co. (Electrical), Ltd.**—Meetings of members and creditors 10th January at the offices of Armitage & Co., Brotherton Chambers, Westgate, Leeds, 1, to receive an account of the winding up from the liquidator, Mr. R. W. Hellyer.

## Bankruptcies

**R. A. Gibson,** lately carrying on business in co-partnership under the style of Gibson & Long, 9, Beech Road, Horfield, Bristol, as electrical and plumbing engineers.—First and final dividend of 6s 0¾d in the £ payable at the offices of E. T. Collins & Son, 28, Baldwin Street, Bristol, 1.

**B. D. Toon** and **T. E. Poole,** formerly trading as electrical dealers in co-partnership under the style of Keverly Services at 625, Bath Road, Brislington, Bristol; 123, Grosvenor Road, St. Pauls, Bristol; Ashley Road, Bristol; and Boar's Head Yard, St. Georges Road, Bristol.—Public examination 2nd March at the Old Council House, Corn Street, Bristol.

**J. W. Bell,** residing and carrying on business at 15, Keighley Road, Cross Hills, nr. Keighley, Yorks., as a radio and television engineer and dealer, under the style of Bell's.—Trustee, Mr. R. W. Hellyer, Brotherton Chambers, Westgate, Leeds, 1, appointed 30th November.

**D. Hill,** lately carrying on business with another at Ongar Road, Brentwood, Essex, and 10, Cromwell Road, Brentwood, under the style of Brentwood Electronics.—Public examination 30th January at 102, Alexandra Road, Southend-on-Sea.

**C. Sykes,** electrician, 10, High Kepplewray, Broughton-in-Furness, Lancashire.—Supplemental dividend of 7½d in the £ payable at the office of the Official Receiver, 14, Lowther Street, Carlisle.

**A. E. N. Packer,** also known as A. E. N. Parker, carrying on business under the style of Parker Radio at 9, Shopping Way, Sandpits, Keresley, Coventry, and Brookville Buildings, Holbrooks Lane, Coventry, as a radio, television and domestic appliance retailer.—Trustee, Mr. R. A. Hawken, Bank Chambers, 1, John Street, Bedford Row, London, W.C.1, appointed 1st December.

**P. G. Miller,** electrician, formerly carrying on business at 2, Laurel Grove, Withington, Manchester, and lately at 121, Love Lane, Heaton Norris, Stockport, Ches., as an electrical engineer and contractor.—Trustee, Mr. W. H. Meredith, 20, Byrom Street, Manchester, released 30th November.

**J. B. English,** electrical engineer, carrying on business at 1, Harrogate Court, Corby, under the style of W.M.S. (Corby).—Trustee, Mr. R. A. Palmer, 45, Sheep Street, Northampton, appointed 5th December.

**B. Holmes,** formerly carrying on business in the style of B. Holmes Electric, at electrical workshops off Institute Lane, Alfreton, and 37, Market Street, Clay Cross, Derbyshire, as a dealer in electrical goods.—Receiving order made 6th December on debtor's petition.

**H. G. Duff,** residing and carrying on business at 4, Halliday Grove, Leeds, previously carrying on business at 7, Canal Road, Leeds, and 8, Dodsworth Court, Leeds, as a radio, television and electrical dealer.—Last day for receiving proofs for dividend 2nd January. Trustee, Mr. N. Saddler, Pearl Chambers, East Parade, Leeds, 1.

## PUMPING PLANT CONTRACTS

CONTRACTS valued together at more than £350,000 for pumping machinery for the new Bristol drainage scheme and extensions to the East Worthing sewage works have been received by W. H. Allen, Sons & Co., Ltd. The plant to be supplied in connection with the Bristol scheme consists of two 33/33in vertical-spindle, mixed flow, dry-well pumps driven by 245 h.p., 485 r.p.m. Laurence, Scott variable-speed motors, and four 33/33in suspended, vertical-spindle, mixed-flow, wet-well pumps driven by 240 h.p., 485 r.p.m. Allen constant-speed motors. The pumps are each designed for a normal duty of 20,250 gal/min against a head of 31ft. The associated power plant comprises four Allen eight-cylinder, 704 b.h.p., dual-fuel engines each driving a 494 kW, 3·3 kV, 50 c/s self-regulating alternator. The supply from the power house to the pumping station 3,500ft away will be by 3·3 kV cable. Instrumentation and control gear includes telemetering equipment to sense anticipated increases in demand for power at the pumping station and to relay that information to the power house.

Sub-contracts in connection with switchgear and control equipment have been placed with Crompton Parkinson, Ltd., and the Brush Electrical Engineering Co., Ltd.

For East Worthing the power plant comprises three six-cylinder, 300 b.h.p., 600 r.p.m. dual-fuel engines, each of which drives a 208 kW, 415 V, 50 c/s self-regulating alternator. Waste heat from the engines to be supplied under both contracts will be utilised in sewage treatment processes from which sludge gas will be available as the main fuel for the engines. The pumping plant to be supplied will consist of three 18/16in vertical-spindle, mixed-flow, volute pumps driven by 82 h.p., 730 r.p.m. Allen constant-speed motors, and two 14/12in pumps driven by 40 h.p., 730/645 r.p.m. variable-speed, slip-ring motors. The constant-speed pumps have a normal duty of 6,550 gal/min against a head of 29·5ft, whilst the variable-speed pumps have a normal duty of 3,275/2,180 gal/min against a total head of 29·5/28ft.

Extensive ancillary equipment, switchgear and control gear is being provided for the Worthing power and pumping houses, the main sub-contractors being A. Reyrolle & Co., Ltd., and Allen West & Co., Ltd.

# NEW PATENTS

## Electrical Specifications Recently Published

*The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (4s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2*

**1956**

38092. Standard Telephones & Cables, Ltd.—Regulated electrical power supply equipment. 6th December, 1957. (882169.)

**1957**

4997. British Insulated Callender's Cables, Ltd.—Electric cable joints or terminations. 12th February, 1958. (882170.)

6724. English Electric Co., Ltd.—Mica insulating material. 26th February, 1958. (882717.)

7918. English Electric Co., Ltd.—Electrical relay systems. 7th March, 1958. (882436.)

11465. Thomas French & Sons, Ltd.—Electric space heating devices. 9th April, 1958. (882438.)

11930. Engelhard Development Co. of Canada, Ltd.—Electrical circuits. 16th April, 1958. (882439.)

15267. English Electric Co., Ltd.—Electric circuit interruptors. 13th May, 1958. (882247.)

21306. English Electric Co., Ltd.—Devices for supporting fuel elements in a nuclear reactor. 3rd October, 1958. (882633.)

26603. Automatic Telephone & Electric Co., Ltd.—Electrical attenuation measuring instruments. 23rd July, 1958. (882171.)

31322. Associated Electrical Industries, Ltd.—Oscillators incorporating transistors. 19th September, 1958. (882195.)

36487. Philips Electrical Industries, Ltd.—Transistor circuit arrangements. 22nd November, 1957. (882172.)

36617. United Kingdom Atomic Energy Authority.—Nuclear reactors. 13th November, 1958. (882651.)

37352. Nippon Telegraph & Telephone Public Corporation.—Pulse responsive control circuit. 29th November, 1957. (882230.)

38095. Texas Instruments, Inc.—Thermally responsive snap-acting electric switch. 6th December, 1957. (882105.)

39314. Electrolux A.B.—Insulation of electrical windings in rotary electrical machines. 18th December, 1957. (882106.)

**1958**

464. Standard Telephones & Cables, Ltd.—Production of pure semiconductor material. 2nd January, 1959. (882719.)

3217. Brown, Boveri & Cie. A.G.—Insulation. 30th January, 1958. (882323.)

8539. Baermann, M.—Material with permanent magnetic properties. 17th March, 1958. (882712.)

11769. Netherlands Director General of Posts, Telegraphs & Telephones.—Method and equipment for transmitting telegraph signals in two-way circuits with error detection and automatic repetition. 14th April, 1958. (882206.)

13064. T.M.M. (Research), Ltd.—Electric motors. 4th June, 1959. (882330.)

14417. Allied Ironfounders, Ltd.—Apparatus for thermally conditioning heat accumulative elements. 28th April, 1959. (882177.)

15299. Hellermann, Ltd.—Method of connecting screened electrical conductors. 8th May, 1959. (882487.)

21817. Allmänna Svenska Elektriska A.B.—Electric condenser. 8th July, 1958. (882179.)

22299. Olympia Werke A.G.—Controllable gate circuit. 11th July, 1958. (882727.)

24005. Licentia Patent - Verwaltungs-G.m.b.H.—Arrangement of electric semiconductor rectifiers. 25th July, 1958. (882375.)

25522. Warmex, Ltd., and Goldstein, A.—Electrically heated blankets and the like. 28th July, 1958. (882467.)

25731. Radyne, Ltd.—Radio frequency dielectric heating apparatus. 11th November, 1959. (882441.)

27216. Kanthal A.B.—Connections for electrical resistance elements. 25th August, 1958. (882699.)

28499. United Kingdom Atomic Energy Authority.—Nuclear reactors. 18th August, 1959. (882714.)

30770. National Research Development Corporation.—Two-part electric couplings. 16th December, 1959. (882216.)

33934. Standard Telephones & Cables, Ltd.—Magnetic information storage arrangements. 23rd October, 1958. (882525.)

36803. A.E.I.-John Thompson Nuclear Energy Co., Ltd.—Control means for nuclear reactors. 6th November, 1959. (882361.)

37025. Fielden Electronics, Ltd.—Means for converting a mechanical force into an electrical current. 9th November, 1959. (882444.)

37351. Bristol Co.—High speed electromagnetic switching device. 20th November, 1958. (882682.)

38105. General Electric Co., Ltd.—Thermally operated electric switches. 13th November, 1959. (882314.)

38258. Western Electric Co., Inc.—Electromagnetic wave transmission devices. 27th November, 1958. (882121.)

38845. M-O Valve Co., Ltd., Styles, P. J., and Wyke, R. E. B.—Electric discharge devices. 2nd December, 1959. (882182.)

42078. Associated Electrical Industries, Ltd.—Cathode-ray tube assemblies. 3rd December, 1959. (822429.)

**1959**

730. Westinghouse Electric Corporation.—Electrical pulse counting apparatus. 8th January, 1959. (882219.)

1044. De Havilland Aircraft Co., Ltd.—Electric oscillation generators. 12th April, 1960. (882590.)

1739. Soc. Elettrotecnica Chimica Italiana S.p.A., and Canegallo, G.—Insulating materials for resistance elements. 16th January, 1959. (882591.)

2321. Koehler Manufacturing Co.—Portable electric lamps. 21st January, 1959. (882448.)

4918. Westinghouse Brake & Signal Co., Ltd.—A.c. rectifiers. 18th March, 1960. (882561.)

5027. International Business Machines Corporation.—Electrical memory apparatus. 13th February, 1959. (882253.)

5746. Wilkinson Sword, Ltd., and Graviner Manufacturing Co., Ltd.—Temperature sensitive electric switches. 18th February, 1960. (882377.)

8076. Siemens-Schuckertwerke A.G.—Nuclear reactors. 9th March, 1959. (882689.)

8626. Ottermill Switchgear, Ltd.—Circuit-breakers. 25th February, 1960. (882691.)

8968. Westinghouse Electric Corporation.—Control circuits for electric relays. 16th March, 1959. (882300.)

9768. Eberle, O., and Köhler, H. (trading as Eberle und Köhler Komm-Ges.).—Methods of making electric connections. 20th March, 1959. (882450.)

17509. Shell Research, Ltd.—Transistor circuits. 22nd May, 1959. (882593.)

18961. Marconi's Wireless Telegraph Co., Ltd.—Microwave waveguide devices. 8th September, 1959. (882594.)

21023. Willem Smit & Co.'s Transformatorenfabrik N.V.—Transformer or choke coil for high voltages having a specially insulated and screened winding. 18th June, 1959. (882379.)

38726. Sabins, R. C.—A.c.-d.c. rectifier. 16th November, 1959. (882660.)

40477. Collins Radio Co.—Delay line phase-pulse generator. 27th November, 1959. (882144.)

**1960**

331. Maeda, H.—Multiple variable capacitor. 5th January, 1960. (882405.)

2392. Standard Telephones & Cables, Ltd.—Electric power cable. 22nd January, 1960. (882615.)

4830. Sealectro Corporation.—Electrical pulse communication systems. 11th February, 1960. (882407.)

5770. Patelhold Patentverwertungs- & Elektro-Holding A.-G.—Microwave resonators. 18th February, 1960. (882408.)

7174. Allmänna Svenska Elektriska A.B.—Method of reducing compressive stresses in radial arms of radial spiders of electrical machines. 1st March, 1960. (882265.)

11041. Pirelli S.p.A.—Stop joints for high tension oil-filled single-core electric cables. 29th March, 1960. (882618.)

18143. Bendix Corporation.—Low-resistance electrolytic tilt switch. 23rd May, 1960. (882578.)

20691. Amp, Inc.—Electrical connectors and connections. 13th June, 1960. (882620.)

21168. American District Telegraph Co.—Signalling circuit. 16th June, 1960. (882413.)

31176. Standard Telephones & Cables, Ltd.—Method of manufacturing electrolytic capacitors. 9th September, 1960. (882581.)

33135. Bristol Co.—Adjustable electric switch contact assembly. 20th November, 1958. (882684.)

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## TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 6th January.

**Loadmaster.** No. 814,053. Class 9. Miniature electric circuit-breakers.—Dorman & Smith, Ltd., Atherton Works, Blackpool Road, Preston, Lancs.

**Mimlarm.** No. 818,087. Class 9. Apparatus for alarm and warning systems; signalling, indicating, and recording apparatus.—Mimic Diagrams, Ltd., 35, Bagshot Street, London, S.E.17.

**Proxamatic.** No. 820,483. Class 9. Burglar and fire alarms and alarm systems.—Burgot Alarms, Ltd., 26, Westbourne Grove, London, W.2.

**Proximitron.** No. 821,037. Class 9. Electrical apparatus and instruments for sensing the position or nature of a metallic object.—Mec-Test, Ltd., Henrietta House, Henrietta Place, London, W.1.

**Vibraswitch.** No. 821,131. Class 9. Electric and electronic instruments for testing and indicating faults in bearings, prime movers, vehicles and the like, by means of electrical switches.—Ether, Ltd., Tyburn Road, Erdington, Birmingham, 24.

**Tempic.** No. 824,003. Class 9. Electronic apparatus for regulating and automatically controlling the temperature of a plurality of individual heat zones in textile machines.—Fielden Electronics, Ltd., Paston Road, Wythenshawe, Manchester, 22.

**Fridgimaster.** No. B822,880. Class 11. Refrigerators and refrigerating apparatus.—Coolcraft, Ltd., Transport Wharf, Dickerage Lane, New Malden, Surrey.

**Aurama.** No. 823,084. Class 11. All goods included in Class 11.—Thorn Electrical Industries, Ltd., Thorn House, St. Martin's Lane, London, W.C.2.

# Calendar of Events in 1962

**Friday, 5th January.**—University College, Gower Street, London. Ministry of Health and the D.S.I.R. Building Research Station. Symposium on "Hospital Lighting."

**Monday, 8th to Friday, 12th January.**—Lecture Hall, Central Hall, Westminster, S.W.1. Institutions of Mechanical and Civil Engineers and the American Society of Mechanical Engineers. International Heat Transfer Conference.

### SCIENTIFIC INSTRUMENTS EXHIBITION

**Monday, 15th to Friday, 19th January.**—Old and New Halls, Royal Horticultural Society, Vincent Square, Westminster, S.W.1. Institute of Physics and the Physical Society. Annual Exhibition.

**Wednesday, 17th and Thursday, 18th January.**—Savoy Place, London, W.C.2, 5.30 p.m. I.E.E. Electronics and Communications Section. Symposium on "Electronic Aids to Banking." (Under the aegis of the British Conference on Automation and Computation.)

**Tuesday, 23rd to Friday, 26th January.**—Royal Commonwealth Society, Northumberland Avenue, London, W.C.2. E.D.A./E.A.W. Demonstrators' Conference.

**Tuesday, 23rd January to Thursday, 1st February.**—Earls Court, London. Hotel and Catering Exhibition.

**Friday, 26th January.**—Grand Hotel, Brighton. Electrical Industries Benevolent Association, Sussex Centre. Annual Ball.

**Tuesday, 30th January to Thursday, 1st February.**—Royal Horticultural Society's New Hall, Westminster, S.W.1. 18th Amusement Trades Exhibition.

**Tuesday, 13th February.** — Grosvenor House, London, 6.30 for 7 p.m. Electrical Contractors' Association. Annual dinner.

**Wednesday, 14th February.**—Central Hall, Westminster, S.W.1. I.E.E. Faraday Lecture. "Expanding Horizons in Communications," by D. A. Barron.

**Friday, 16th to Tuesday, 20th February.**—Paris. International Radio and Electronic Components Exhibition.

### E.D.A. SALES CONFERENCE

**Tuesday, 20th to Friday, 23rd February.**—Royal Hall, Harrogate. British Electrical Development Association. Sales Conference and Exhibition.

**Thursday, 22nd February.**—Grosvenor House, London, 7 for 7.30 p.m. Institution of Electrical Engineers. Annual dinner.

**Friday, 23rd to Monday, 26th February.**—Cologne. Spring International Goods and Hardware Fair. Joint Board of Trade and B.E.A.M.A. Display.

**Monday, 26th to Wednesday, 28th February.**—London. Conference on "The Importance of Electricity in the Control of Aircraft." Institution of Electrical Engineers and the Royal Aeronautical Society.

**Sunday, 4th to Tuesday, 13th March.**—Leipzig. Spring Fair.

**Tuesday, 6th to Saturday, 31st March.**—Olympia, London. *Daily Mail* Ideal Home Exhibition.

**Thursday, 15th March.** — Connaught Rooms, London, W.C.2. B.E.A.M.A. annual general meeting.

### ELECTRICAL ENGINEERS EXHIBITION

**Tuesday, 20th to Saturday, 24th March.**—Earls Court, London. Electrical Engineers Exhibition.

**Thursday, 22nd March.**—Park Lane Hotel, London. Electrical Wholesalers' Federation. Annual general meeting. Dorchester Hotel. Annual dinner.

**Friday, 30th March.**—Dorchester Hotel, London. Scientific Instrument Manufacturers' Association. Annual dinner and dance.

**Wednesday, 4th to Friday, 6th April.**—Bournemouth. Institute of Physics and the Physical Society. Symposium on "The Physics of Graphite Moderated Reactors."

**Monday, 9th to Thursday, 12th April.**—Earls Court, London. Refrigeration, Air Conditioning and Frozen Foods Exhibition.

**Friday, 13th April.**—Grosvenor House, London, W.1. Association of Supervising Electrical Engineers. Annual dinner and reunion.

**Friday, 13th to Thursday, 19th April.**—Olympia, London. International Refrigeration Fair.

**Thursday, 26th April.**—Institution of Electrical Engineers, Savoy Place, London, W.C.2. Kelvin Lecture.

**Friday, 27th April.**—Savoy Place, London, W.C.2. I.E.E. Measurement and Control Section. Symposium on "Flameproofing, Intrinsic Safety and other Safeguards in Electrical Practice."

**Sunday, 29th April to Tuesday, 8th May.**—Hanover. German Industries Fair.

**Monday, 30th April to Saturday, 5th May.**—Olympia, London. Fifth Production Exhibition.

**Wednesday, 2nd May.**—Savoy Hotel, London, W.C.2. Electrical Research Association. Annual general meeting and luncheon.

**Wednesday, 2nd to Friday, 4th May.**—Buxton. Institute of Welding. Spring Meeting and Exhibition, "Welding for Power Generation."

### I.E.S. CONFERENCE

**Sunday, 6th to Wednesday, 9th May.**—Folkestone. Illuminating Engineering Society. Annual Conference.

**Tuesday, 8th May.**—Savoy Hotel, London, W.C.2. Electrical Development Association. Annual luncheon.

**Tuesday, 8th to Friday, 18th May.**—Earls Court, London. Mechanical Handling Exhibition.

**Thursday, 10th May.**—Savoy Hotel, London, W.C.2. Scientific Instrument Manufacturers' Association. Annual luncheon.

### C.I.G.R.E.

**Wednesday, 16th to Saturday, 26th May.**—Fondation Berthelot, Paris. Conférence Internationale des Grands Réseaux Electriques (C.I.G.R.E.).

### E.C.A. CONFERENCE

**Thursday, 17th to Tuesday, 22nd May.**—Eastbourne. Electrical Contractors' Association. Annual Conference.

**Friday, 18th to Sunday, 20th May.**—Scarborough. Association of Supervising Electrical Engineers. Summer Meeting.

**Friday, 18th May to Sunday, 3rd June.**—Stockholm. British Trade Fair.

**Saturday, 26th May to Monday, 11th June.**—Liège. 14th International Fair.

### I.E.A. EXHIBITION

**Monday, 28th May to Saturday, 2nd June.**—Olympia, London. International Instruments, Electronics and Automation Exhibition.

**Thursday, 31st May to Thursday, 7th June.**—Savoy Place, London, W.C.2. I.E.E. Electronics and Communications Section. Television Conference.

### POWER CONVENTION

**Monday, 4th to Thursday, 7th June.**—Brighton. British Electrical Power Convention.

**Monday, 18th to Friday, 22nd June.**—Liverpool. Institution of Electrical Engineers. Summer Meeting.

**Monday, 18th to Friday, 22nd June.**—Scarborough. National and Local Government Officers' Association. Annual Conference.

**Tuesday, 26th to Friday, 29th June.**—Edinburgh. Association of Mining Electrical and Mechanical Engineers. Annual Convention.

**Tuesday, 3rd to Friday, 6th July.**—Town Moor, Newcastle-upon-Tyne. Royal Agricultural Society's Show.

**Wednesday, 4th July.**—Savoy Place, London, W.C.2. Institution of Electrical Engineers. Symposium on "Electric Traction."

**Monday, 16th to Friday, 20th July.**—University, Exeter. International Conference on Physics of Semiconductors.

### RADIO SHOW

**Wednesday, 22nd August to Saturday, 1st September.**—Earls Court, London. Radio and Television Exhibition.

**Wednesday, 29th August to Wednesday, 5th September.**—Manchester. British Association for the Advancement of Science. Annual meeting.

**Monday, 3rd to Sunday, 9th September.**—Farnborough, Hants. Society of British Aircraft Constructors. Annual Flying Display and Exhibition.

**Tuesday, 18th to Friday, 21st September.**—Blackpool. Association of Public Lighting Engineers. Annual Conference.

**Friday, 21st to Saturday, 29th September.**—Earls Court, London. Commercial Motor Transport Exhibition.

**Monday, 1st to Wednesday, 10th October.**—Olympia, London. Business Efficiency Exhibition.

**Wednesday, 17th to Saturday, 27th October.**—Earls Court, London. International Motor Exhibition.

### WORLD POWER CONFERENCE

**Saturday, 20th to Friday, 26th October.**—Melbourne, Australia. World Power Conference. Sixth Plenary Meeting.

### ELECTRICAL INDUSTRIES BALL

**Friday, 9th November.**—Grosvenor House, London. Electrical Industries Benevolent Association. Annual Ball.

**Monday, 12th to Saturday, 17th November.**—Olympia, London. Public Works and Municipal Services Congress and Exhibition.

**Monday, 3rd to Friday, 7th December.**—Earls Court, London. Royal Smithfield and Agricultural Machinery Show.

**Wednesday, 5th to Friday, 7th December.**—National Hall, Olympia, London. National Poultry Show.

# CONTRACT INFORMATION

## Accepted Tenders and Prospective Electrical Work

### CONTRACTS OPEN

**Australia.**—State Electricity Commission of Victoria. 8th January. Insulators and switchgear. (E.S.B. 37950-51/61.)*

Townsville Regional Electricity Board, North Queensland. 7th February. S.c.a. conductor. (E.S.B. 37999/61.)*

Secretary, Victorian Railways, Melbourne. 28th February. Telecommunication equipment. (E.S.B. 37902/61.)*

**Bath.**—City Council. 10th January. Street lighting equipment for one year to 31st March, 1963. City engineer, Guildhall.

**Camborne-Redruth.**—U.D.C. 27th January. Supply of electrical equipment and fittings for the year ending 31st March, 1963. S. C. Wilson, clerk, Council Offices, Camborne.

**Ceylon.**—Tender Board, Ministry of Agriculture, Land, Irrigation and Power, Colombo. 23rd January. Armoured cable. (E.S.B. 37208/61.)*

**France.**—Purchasing and Contracting Officer, A.C.E., Signal Division, Materials Branch, S.H.A.P.E., Paris. 17th February. Communications equipment. (E.S.B. 37923/61.)*

**India.**—Maharashtara State Electricity Board, Bombay. 15th January. 66 kV switchgear. (E.S.B. 37982/61.)* 1st February. Insulators, conductors and cables. (E.S.B. 37979/61.)* 9th February. Transmission line towers. (E.S.B. 37980/61.)* 15th February. Electrical substations. (E.S.B. 37981/61.)*

Chittaranjan Locomotive Works. 8th March. Electric traction equipment. (E.S.B. 37908/61.)*

Eastern Railway, Calcutta. 14th May. Railway signalling equipment. (E.S.B. 37906/61.)*

Punjab State Electricity Board. 15th January. Fuses. (E.S.B. 37989/61.)* Closing dates from 23rd January to 21st March. Cables. (E.S.B. 37984-8/61.)*

**Pakistan.**—Electricity, W.A.P.D.A., Lahore. 16th January. Fuse carriers and cut-outs. (E.S.B. 38257/61.)*

**Philippines.**—National Power Corporation, Manila. Five turbines and generators. (E.S.B. 37972/61.)*

**Rhodesia and Nyasaland.**—Salisbury Stores Department. 5th June. Street lanterns. (E.S.B. 38000/61.)*

**Skipton.**—U.D.C. 8th January. Rewiring 149 houses, Burnside estate. (See Classified Advertisement Section.)

**Sudan.**—Controller, Stores and Workshops, Posts and Telegraphs Department, Khartoum South. 13th January. Insulators. (E.S.B. 37992/61.)*

**United States.**—Bureau of Reclamation, Denver, Colorado. 9th January. 138 kV circuit-breakers. (E.S.B. 37937/61.)*

**Wood Green.**—Borough Council. 5th January. Electric lamps, including those for street lighting purposes, for the year commencing 1st April, 1962. Borough engineer and surveyor, Town Hall, Wood Green, N.22.

### ORDERS PLACED

**Darlington.**—Corporation. Electrical work in connection with the new Branksome Secondary School (£14,546).—Cox-Walkers.

**Newcastle-on-Tyne.** — Regional Hospital Board. Electrical work in connection with additions to Stockton and Thornaby Hospital (£1,104).—Doves. Electrical work and telephone installation at Cumberland Infirmary, Carlisle (£4,383).—James Scott & Co. (Electrical Engineers).

### WORK IN PROSPECT

*Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors*

**Aylesbury.**—Houses (43), in six parishes; R.D.C. surveyor, Buckingham Street.

**Aylesford.**—Sewage treatment works; Howard Humphreys & Sons, consulting engineers, West Street, Epsom.

**Barnsley.**—Conversions at Alhambra Cinema to form supermarket; Rank Property Development, Ltd., 111, Westminster Bridge Road, London, S.E.1.

**Basingstoke.**—Factory extension for L. N. Van Moppes, Ltd., Winchester Road; Percy Bilton, Ltd., 77, Uxbridge Road, W.5.

**Bexleyheath.**—Extensions for technical school; J. Stinton Jones & Partners, consulting engineers, 21, Gloucester Place, W.1.

**Birmingham.**—Works, Vauxhall Road; Birmingham Typesetters, Ltd., 133, New John Street.

**Blackburn.**—Two major health centres, Montague Street and Bottomgate; borough engineer, Town Hall.

**Burnley.**—Extensions to St. Hilda's School (£50,000), for R.C. Diocesan Trustees; P. R. Nuttall, architect, 5, Kay Street, Rawtenstall.

**Cambridge.**—Fire station and headquarters on site fronting Parkside (£181,250); county architect, Shire Hall, Cambridge.

**Chatham.**—Hotel and flats, Station Hotel site; Abbey Homesteads, Ltd., 15, Thayer Street, W.1.

**Corby.**—Flatlets (24), warden's flat, laundry and community room, Studfall Avenue; U.D.C. surveyor.

**Cumbernauld.**—Multi-storey block of 64 flats, Kildrum No. 1 development; chief architect and planning officer to Development Corporation, Cumbernauld House, Cumbernauld, Glasgow.

**Dartford.**—Extensions, Priory Road Mills; Wiggins, Teape & Co., Ltd., 1, Watling Street, E.C.4.

**Desborough (Northants).**—Dwellings (33), Rushton Road estate; U.D.C. surveyor.

**Doncaster.**—Bungalows for old people at Intake, Cantley estate, Woodfield, Wheatley Park and Carr House; borough architect.

Works extensions; R. O. Arnold, Ltd., Wheatley Hall Rroad.

**Eastleigh.**—Oakmount County Junior School, Chandlers Ford; county architect, The Castle, Winchester.

**Edinburgh.**—Bonded warehouse, Slateford Road (£130,000); North British Distillery Co., Ltd., Wheatfield Road, Edinburgh.

**Finchley.**—Mental health recuperative hostel, Park House site, High Road (£46,120); county architect, 1, Queen Anne's Gate Buildings, London, S.W.1.

**Frimley and Camberley.**—Maisonnettes (72), Old Dean estate, for U.D.C.; Close & Morton, quantity surveyors, 20-22, High Street, Camberley.

**Glasgow.**—Works, Polmadie Road; The Davy & United Engineering Co., Ltd., Sumner Street.

Ten-storey block of flats, Pollokshaws; city architect.

**Haverhill.**—Home for aged, Place Farm site; county architect, 13, Westgate Street, Bury St. Edmunds.

**Hinckley.**—R.C. junior school, Stoke Golding; Bartlett & Gray, architects, 14/16, West Bridge Road, Nottingham.

**Leeds.**—Seventeen-storey block of flats and four-storey blocks of maisonnettes, Marlborough Street; city architect, Priestley House, Quarry Hill, 9.

**Liverpool.**—Shops, Bold Street; Shop Construction Group, 12, St. George Street, London, W.1.

**London.**—Extension to Eltham College, Grove Park Road, Eltham; Seely & Paget, architects, 41, Cloth Fair, E.C.1.

Customs Offices, Royal Albert Dock, North Woolwich; John Mowlem & Co., Ltd., 91, Ebury Bridge Road, S.W.1.

Fifteen-storey block of flats, Plaistow; Thomas E. North, architect, 70, West Ham Lane, E.15.

Dwellings (252), Glyndon Road area, Woolwich; borough engineer.

**Manchester.**—William Temple Memorial Church, Wythenshawe; G. G. Pace, architect, 18, Clifton Green, York.

**Merthyr Tydfil.**—Aged persons' hostel, Gurnos estate; borough architect.

**Newcastle-on-Tyne.**—Maisonnettes (64), Scotswood redevelopment area, and Charles Trevelyan County Primary School, Cruddas Park; city architect, 18, Cloth Market.

**Northumberland.**—Old people's home at Ashington (£70,000); county architect, 30, Great North Road, Newcastle-on-Tyne.

**Perth.**—Flats (48), Potterhill House site, Bridgend; burgh surveyor, 16, Tay Street.

**Pitsea.**—Maisonnettes (56), Victoria Road; K. S. Cotton, architect, 88, Town Square, Basildon.

**Poole.** — Maisonnettes (30), Langland Street; borough architect.

**Port Talbot.**—Houses (100), Baglan; G. V. Griffiths, borough engineer, Municipal Buildings.

**Richmond.**—Flats (98), Popiary site; Master Flats, Ltd., 8, Berkeley Street, W.1.

**St. Albans.**—R.C. church and presbytery, Vesta Avenue; P. Mauger & Partners, architects, 31, Church Street, Welwyn.

**South Shields.**—Youth centre, Green Lane, Simonside; J. Reid, borough engineer.

**Stanley.**—Houses (364), West Shield Row, Stanley; R. H. Snowball, U.D.C. surveyor.

**Sunderland.**—Factory, Pallion trading estate; Perdio Radio, Ltd., 6, Bonhill Street, E.C.2.

**Swindon.**—Houses (90), Park South; borough architect.

**Wakefield.**—Shopping block, 1-7, Northgate; Langdon & Every, quantity surveyors, 4, Church Street, Liverpool.

**Washington (Co. Durham).**—Offices and laboratories for the Washington Chemical Co., Ltd.; Powell Duffryn, Ltd., architects, Proctor House, The Side, Newcastle-on-Tyne.

**West Ham.**—Extensions to Queen Mary's Hospital, including two eight-storey blocks, West Ham Lane; regional architect, North East Metropolitan Regional Hospital Board, 40, Eastbourne Terrace, London, W.2.

**Withernsea.**—Houses (122), Clovelley estate; T. R. Barnett & Co., Ltd., Curzon Street, Hull.

**Wycombe.**—Houses (46), Longswick Road, Princes Risborough; R.D.C. surveyor, 17, High Street, High Wycombe.

**York.**—Eight-storey office block, near York Minster; Kitson, Parish, Ledgard & Pyman, architects, Lloyds Bank Chambers, Vicar Lane, Leeds.

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* This information is extracted from the Board of Trade *Export Service Bulletin.* Inquiries should be addressed to the Board of Trade, Export Services Branch, Lacon House, Theobald's Road, London, W.C.2 (Telephone: Chancery 4411, Ext. 738), quoting the reference given.

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**W. H. TAYLOR (WOLVERHAMPTON) LTD.**
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**DRAKE & GORHAM (Contractors) LTD.**
**13 St. Andrew's Crescent, Cardiff**
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**Oxton Road, Birkenhead**
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Electrical Engineers and Contractors for Industrial Installations, Power, Heating, Lighting, Burglar Alarms, Maintenance, Motor Rewinds and Repairs

**HIGGINS & CATTLE LTD.**
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Electrical Engineers and Contractors
**SOUTHERN & REDFERN LTD.**
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Textile Maintenance, Repairs and Rewinds
*Telephones: Bradford 23871—Late Phone: Bradford 65837*

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**REGINALD MAUDE LTD.**
**North Parade Works, St. James Road, Halifax**
*Phones 67201 (3 lines)*

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Contracting Electrical Engineers. Motor Rewinds and Repairs
Branches at: GRIMSBY, GOOLE, YORK, WALLSEND

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*Telephone 24015 (3 lines)* *Telegrams: "Whelect"*

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*Telephone 22384-5.* *Telegrams: Marbros. Sheffield.* *Established 1901*
ELECTRICAL INSTALLATION CONTRACTORS
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Power, Heating and Lighting Installations. Factory Maintenance.
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Electrical Engineers and Contractors.
**JOHN RUSHTON & SON**
**161 Great Moor Street, Bolton**
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Industrial and Domestic Installations. Maintenance and Repairs.

**ANGLO-AMERICAN ELECTRICAL COMPANY**
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Electrical Installations: Power, Heating, Lighting.
Manufacturers of Fluorescent Fittings, Ballast Units, etc.

**DRAKE & GORHAM (Contractors) LTD.**
**21 Newton Street, Piccadilly, Manchester 1**
*Telephone: Manchester Central 4701*
Electrical Engineers and Contractors

. . . for all electrical installations
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| Contracting | Manufacturing | Electronic Maintenance |
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| **12 York Street, Manchester 2** | **Shepley Estate, Audenshaw** | **Grosvenor Street, Manchester** |
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**W. J. FURSE & CO. (MANCHESTER) LTD.**
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*Telephone: Blackfriars 5014-5-6*
For Electrical Installations and Contract Work

**JAMES SCOTT & CO. (ELECTRICAL ENGINEERS) LTD.**
**35 Broughton Street, Manchester 8**
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Britain's largest Electrical Installation Organisation for all high-class Electrical Installation and Instrumentation

**CARTER & CO. (NELSON) LTD.**
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*Telephone: Nelson 64638*
FIRE ALARMS AND INDUSTRIAL HEATERS

## NORTH EASTERN

**COX-WALKERS LTD.**
**North Eastern Electric Works, Feethams, Darlington**
Electrical Contractors of repute since 1880. Motor Rewinds and Manufacturing Engineers
*Telephone 66277/8*

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**CITY ELECTRICAL CO.**
**Turks Head Yard, Cecil Street, Lincoln**
*Telephone: Lincoln 124* *London: HOLborn 9722*

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**Argyle House, Argyle Street, Newcastle-upon-Tyne 1**
*Telephone 28605*
Britain's Largest Electrical Installation Organisation for all high-class Electrica Installations and Instrumentation

. . . for all electrical installations
**F. H. WHEELER & CO. LTD.**
**52 Elswick Road, Newcastle**
*Telephone: Newcastle 36271*

(*Continued on page 54*)

(Continued from page 53)

**SOUTH WEST SCOTLAND**

**JAMES SCOTT & CO. (ELECTRICAL ENGINEERS) LTD.**

80/110 Finnieston Street
Glasgow, C.3
*Telephone: Central 3866*

21/25 George IV Bridge
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*Telephone: Caledonian 6424*

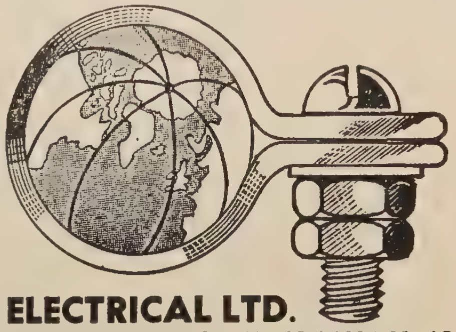
Britain's Largest Electrical Installation Organisation for all high-class Electrical Installation and Instrumentation

**REPUBLIC OF IRELAND**

Electrical Engineering Contractors
**A. G. BRUTY LIMITED**
38 Dawson Street, Dublin
*Telephone: Dublin 73181*

Applications for particulars of costs and standard style of advertisements in this Regional Guide should be addressed to:
THE
ADVERTISEMENT DEPARTMENT,
ELECTRICAL REVIEW
DORSET HOUSE STAMFORD STREET LONDON S.E.1

THE
GOOD
EARTH
BY



**F. RYMAN ELECTRICAL LTD.**
**72 HUNTERS VALE, HOCKLEY, BIRMINGHAM 19**
*Phone: NOR 2403*
MANUFACTURERS OF EARTHING CLIPS (ALL TYPES)
CABLE SOCKETS, COPPER CLAMP WASHERS
QUALITY PRODUCTS ONLY

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of every type

The largest and most comprehensive range of insulating materials in the country.
Supplied in sheet, rod and tube form.

ASBESTOS,
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PLASTICS OF ALL TYPES,
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SLEEVINGS,
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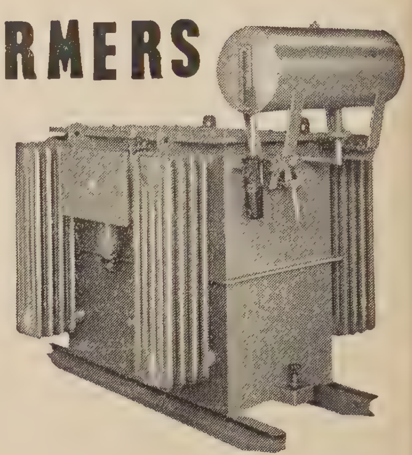
Phone: BIRchfield 6218-9 Grams: Fibre, B'ham 20
Please write or 'phone if further details or samples are required

*Sturdy*
**TRANSFORMERS**



**UP TO 250 KVA**

**ALL TYPES**

Also
- **POWER TRANSDUCTORS**
  for "finger-tip" manual or automatic control of power up to 300 KVA (1-phase) and 750 KVA (3-phase).
- **TRANSFORMER/RECTIFIER SETS**

**STURDY ELECTRIC CO. LTD.**
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*Telephone: Ebchester 271-272. Telegrams: Sturditran, Newcastle upon Tyne*

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**LIGHTNING CONDUCTORS**
**and Earthing Equipment**
Largest Manufacturers and Exporters in Great Britain

*Illustrated Trade Literature available upon request. Advisory and Technical Information Service free*

**W. J. FURSE & CO. LIMITED**
33 Traffic Street (Tel. 83471-5 lines) NOTTINGHAM
Also LONDON, MANCHESTER, BIRMINGHAM, BRISTOL

**MEKELITE**

INDUSTRIAL LIGHTING UNITS

For wall, bench or machine mounting. *Catalogue sent free on request.*

**MEK-ELEK** Engineering Ltd., MITcham 3072
17 Western Road, Mitcham, Surrey.

# Classified Advertisements

**CLASSIFIED** advertisements are PREPAID at 4/- per line (approx. 6 words).

**DISPLAYED CLASSIFIED**:—53/- per single column inch.

Where an advertisement includes a Box Number there is an additional charge of 1/-.

**SERIES DISCOUNTS** for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

**SITUATIONS WANTED**:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

Remittances payable to "ELECTRICAL REVIEW."

**REPLIES TO BOX NUMBERS** should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1. If an applicant for a situation appearing under a Box Number does not wish his reply to be forwarded to a particular firm or individual, instructions to this effect should be addressed to the Advertisement Supervisor, ELECTRICAL REVIEW. The name of an advertiser using a Box Number cannot be disclosed.

**Original testimonials should not be sent with applications for employment**

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## OFFICIAL NOTICES, TENDERS, ETC.

### SKIPTON URBAN DISTRICT COUNCIL

**Rewiring of Electrical Installations**

TENDERS invited for rewiring 149 pre-war Council houses, Burnside Estate.

Contract documents from Engineer and Surveyor, Town Hall, Skipton, on deposit of £2 2s. (refunded on receipt of bona fide tender).

Tenders, in envelope provided, bearing no indication of sender, to be in by 8th January, 1962.

The Council do not bind themselves to accept the lowest or any tender.

L. E. SMITH,
Clerk of the Council.

3280

## SITUATIONS VACANT

*(See "Replies to Box Numbers" above)*

### CENTRAL ELECTRICITY GENERATING BOARD

**North Eastern Region**

**Third Assistant Engineer (Substations & Cables), Regional Transmission Project Branch**

APPLICATIONS are invited from engineers to supervise the work of contractors engaged in the installation of electrical plant including cables at 132-kV, 275-kV and 400-kV substations in the Region.

Candidates should have had previous experience on both the construction and maintenance of substation equipment, but applicants with experience of either will be considered.

It is desirable that the candidates should have qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

The salary for the appointment will be in accordance with the National Joint Board Agreement, Grade 8, Class K (£1,145 - £1,410 per annum).

Forms of application may be obtained from the Regional Personnel Officer, Central Electricity Generating Board, North Eastern Region, 1, Whitehall Road, Leeds, 1, to whom they should be returned to arrive not later than 1st January, 1962.

3272

### BRITISH ENGINE BOILER & ELECTRICAL INSURANCE CO. LTD.

**Longridge House, Manchester, 4**

ELECTRICAL SURVEYORS required. Permanent positions carrying progressive salary scale £825 to £1,225 with non-contributory pension. Candidates, aged 26 to 32, with H.N.C. in Electrical Engineering or Grad. I.E.E., and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply stating age, qualifications and experience.

3264

### CENTRAL ELECTRICITY GENERATING BOARD

**Midlands Region**

**Assistant Engineer (Operation), Drakelow "B" Power Station, West Midlands Division**

APPLICATIONS are invited for the appointment of ASSISTANT ENGINEER (Operation) at Drakelow "B" Power Station, near Burton-on-Trent. N.J.B. service conditions, superannuable appointment, salary within Schedule A of the Agreement, Grade L.10, £1,190-£1,325 per annum plus 10% for shift duties.

Applicants should have received a sound technical training and practical experience in the operation of steam generating plant and main switchgear, and a knowledge of P.F. firing is desirable. Appropriate technical qualifications would be an advantage.

Apply, quoting Vacancy No. 304/61 MR, on application form AE.6, available from the Station Superintendent, Drakelow Power Station, near Burton-on-Trent, to be completed and returned by 1st January, 1962.

3277

### SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT DISTRICT ENGINEER, Central Sussex District.

Salary £1,040 to £1,165 per annum in accordance with N.J.B. Class F, Grade 7. Applicants should be qualified engineers and have had training and experience in planning, construction, operation and maintenance of underground and overhead distribution systems up to 33 kV. The District is 298 sq. miles in area and the units sold in 1960/61 were 199 millions. It is expected that the District classification will be raised to G in 1962 or 1963.

Transport will be provided or the successful candidate may elect to use his own car on Board's business with the appropriate allowance. Rented living accommodation may be offered to the successful candidate.

Applications, quoting E.R., and naming two referees, to District Manager, SEEBOARD, Electra House, Church Road, Haywards Heath, Sussex, by 3rd January, 1962.

GEORGE WRAY,
Secretary.

3270

### TECHNICAL SALES REPRESENTATIVE

required by old-established company in electric light fittings. Diploma Members of the Illuminating Engineering Society preferred. Vacancies exist in the following areas:—

LANCASHIRE and NORTH-WEST.
YORKSHIRE and NORTH-EAST.
MIDLANDS.
SOUTH WALES.
SCOTLAND.

Excellent opportunities for selected personnel in rapidly expanding organisation.

Applications will be treated in strictest confidence. Please reply to—Box 3250.

### CHRISTMAS

ADVERTISEMENTS for the issue of 29th December have now closed for press

Advertisements are accepted up to **first post on Monday** of the week of issue

If blocks, bold type or ruled borders are required then on **Friday** prior to week of issue

All communications to be addressed to:
Classified Advertisement Department,
ELECTRICAL REVIEW
Dorset House, Stamford Street
London, S.E.1

### CENTRAL ELECTRICITY GENERATING BOARD

**South Eastern Region, North Thames Division**

APPLICATIONS are invited for the following appointment at LITTLE BARFORD GENERATING STATION, ST. NEOTS, HUNTS.

GENERAL ASSISTANT ENGINEER (S.V. No. 1569).

Salary N.J.B. Class J, within the range of Grades 17/15, Scales 1-3, £625 - £805 per annum, plus £90 per annum shift allowance whilst engaged on shift duties.

The commencing salary will depend upon the duties and responsibilities.

Duties of the above post include assisting in the electrical control room and experience in the technical operation of electrical, boiler house and turbine house plant, testing, etc., in a generating station, and provide a suitable basis for promotion to higher technical grades.

Manual workers in skilled grades with suitable technical training will be considered. Previous experience in a generating station and/or technical training to the standard of Ordinary National Certificate or its equivalent will be of advantage.

Housing accommodation may be available for the successful applicant.

Applications, quoting reference S.V. No. 1569, stating age, qualifications, previous experience and present position, should be sent to the Assistant Regional Personnel Officer, Central Electricity Generating Board, South Eastern Region, North Thames Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts., to arrive not later than the 6th January, 1962.

F. W. SKELCHER,
Assistant Regional Director.

3281

### CABLE ENGINEERS

between 20 and 40 years of age, required for the development and design of supertension cables and accessories. High-voltage laboratory experience desirable.

Applicants should possess H.N.C. or Degree in Electrical Engineering, although for some appointments an interest in electronics would be valuable. Graduate or Corporate Membership of I.E.E. an advantage but not essential.

Apply, giving full details, to:—

**Engineering Manager, Supertension Dept.**
**ASSOCIATED ELECTRICAL INDUSTRIES (WOOLWICH) LTD.**
**Cable Division, Gravesend, Kent**

3267

*Situations Vacant* (*continued*)

### SOUTH OF SCOTLAND ELECTRICITY BOARD

**Edinburgh and Borders Area**

**Third Assistant Engineer (Meters, Test and Protection)**

**Salary N.J.B. Schedule A, Class L, Grade 10, £1,190/£1,325 per annum**

APPLICATIONS, on the standard form, obtainable from the undersigned, should be submitted not later than 15th January, 1962.

Conditions of service in accordance with the N.J.B. Agreement for the Electricity Supply Industry; the successful candidate, subject to satisfactory evidence of health, will require to become a contributor to the Board's superannuation scheme.

Applicants should hold the H.N.C. (Electrical Engineering) or equivalent, and have some experience in commissioning new substations and routine testing and maintenance of protective gear.

The successful applicant will require to reside within a reasonable distance of Area Headquarters, Edinburgh.

C. H. A. COLLYNS,
Manager.

52, Melville Street,
Edinburgh, 3.

3266

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### CENTRAL ELECTRICITY GENERATING BOARD

**Midlands Region**

**Shift Charge Engineer, Drakelow "A" Power Station, West Midlands Division**

APPLICATIONS are invited for the appointment of SHIFT CHARGE ENGINEER at Drakelow "A" Power Station, near Burton-on-Trent. N.J.B. service conditions, superannuable appointment, salary within Schedule A, Grade J.6, £1,350-£1,500 per annum plus 10% shift allowance.

A sound technical training and practical experience in the operation and maintenance of steam generating plant and main switchgear in a large modern power station are required, also a knowledge of P.F. firing. The station is one of advanced design. Appropriate qualifications an advantage.

Apply, quoting Vacancy No. 305/61 MR, on application form AE.6, available from the Station Superintendent, Drakelow Power Station, near Burton-on-Trent, to be completed and returned by 1st January, 1962.

3276

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### INSPECTOR OF WORKS (ELECTRICAL)

required by UGANDA GOVERNMENT Public Works Department. Appointment on contract for 1 tour of 21-27 months in first instance. Salary according to age and experience in scale (including inducement pay) rising to £1,671 a year. Gratuity 25% of total salary drawn. Outfit allowance £30. Children's education allowances. Free passages. Liberal leave on full salary.

Candidates should be 29-40 years of age and must possess at least O.N.C. (Electrical) or equivalent qualification. They should also have served a full apprenticeship and had subsequent experience in maintenance of industrial electrical equipment and large installations. They must be fully conversant with U.K. Home Office Electricity Rules, Electricity Regulations under the Factories Act, and those of the Electrical Commissioners.

Apply to CROWN AGENTS, 4, Millbank, London, S.W.1, for application form and further particulars, stating age, name, brief details of qualifications and experience, and quoting reference M2/50987/EF.

3269

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**Eastern Electricity**

**Chilterns Sub-Area**

AYLESBURY DISTRICT

FIRST ASSISTANT DISTRICT COMMERCIAL ENGINEER
(260/61.R).

Candidates should have had a good general and technical education and experience in electrical contracting and maintenance work. The successful applicant will be responsible to the District Commercial Engineer for the supervision of general contracting and wiring installation work, including estimating for all types of industrial, agricultural and domestic installations. Experience in the design and installation of thermal storage heating systems, including floor warming installation, would be an advantage.

Salary N.J.B. Class F, Grade 6, £1,115-£1,245 per annum.

Apply by letter to the Manager, Aylesbury District, Eastern Electricity, Exchange Street, Aylesbury, by 5th January, 1962.

**Essex Sub-Area**

CHELMSFORD DISTRICT

FOURTH ASSISTANT ENGINEER
(261/61.R).

Applicants should have had a sound technical training and some experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems, including substations.

Salary N.J.B. Class G, Grade 11, £825-£940 per annum.

Apply by letter to D. H. Walker, Manager, Chelmsford District, Eastern Electricity, Anchor Street, Chelmsford, Essex, by 5th January, 1962.

3279

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### ELECTRICAL/INSTRUMENT INSTRUCTOR

LARGE oil company operating in Middle East (Arabian Gulf) requires an INSTRUCTOR to train young local employees as electrical and instrument mechanics. The successful applicant will be expected to devise imaginative methods of dealing with young men whose English and background knowledge are limited.

Applicants should hold at least O.N.C. or equivalent in electrical engineering, and have both practical and theoretical knowledge of general instrumentation techniques and considerable experience of instructing technicians, preferably linked to the City and Guilds range of courses and standards.

The post is pensionable with gross pay not less than £2,500 per annum. No income tax at present. Annual leave with paid passages. Fully furnished, air-conditioned accommodation provided at reasonable rental, but married applicants should be prepared for initial separation.

Applicants should write in detail, quoting O/S 7, to Box No. 4413, c/o Charles Barker & Sons Ltd., 20, Cannon Street, London, E.C.4.

3261

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### NORTH WESTERN ELECTRICITY BOARD

**(a) Third Assistant Engineer (Senior Charge Engineer)**
**(b) Fourth Assistant Engineer (Charge Engineer)**

**Operation Section, Sub-Area Engineering Department, Manchester**

APPLICATIONS are invited for the above posts in the Sub-Area Central Control Room.

POST (a).

The duties include operational control of a large E.H.V. transmission and distribution system interconnecting a number of power stations by supervisory control and system switching.

POST (b).

The duties include assisting the Senior Charge Engineer in the above work.

The engineers appointed will be required to perform shift duties. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

SALARY SCALES :—
POST (a) £1,275/£1,410 p.a. plus 10% shift allowance. Grade M.10.
POST (b) £1,115/£1,245 p.a. plus 10% shift allowance. Grade M.12.

N.J.B. conditions.

Applications on forms to be obtained from the Manager (Staff Vacancy), No. 1 Sub-Area, North Western Electricity Board, Town Hall, Manchester, 2, P.O. Box 493, and returned to him by 4th January, 1962.

3271

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### CENTRAL ELECTRICITY GENERATING BOARD

**Midlands Region**

**Fourth Assistant Engineer, System Operation Department, West Midlands Division**

APPLICATIONS are invited for the appointment of FOURTH ASSISTANT ENGINEER in the System Operation Department, Birmingham. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Class L, Grade 11, £920-£1,245 per annum.

The duties of the post are mainly statistical, and applicants should have had a sound technical education to Ordinary National Certificate as a minimum, and preferably have had power station experience.

Apply, quoting Vacancy No. 309/61 MR, on application form AE.6, available from the System Operation Engineer, Warwick House, Redhill Road, West Heath, Birmingham, 30, to be completed and returned by 1st January, 1962.

3278

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### HUNTINGDONSHIRE COUNTY ARCHITECT'S DEPARTMENT

**Technical Assistant (Electrical Engineer)**

APPLICATIONS are invited for the above appointment on Grade A.P.T. III (£960-£1,140) or Grade A.P.T. IV (£1,140-£1,310) according to qualifications.

The person appointed will be a member of the Engineering Section of the Department, and his duties will consist of all works connected with electrical installations related to both small and large building projects.

Application forms may be obtained from the Deputy County Architect, County Buildings, Huntingdon, and completed forms should be returned to the undersigned by Saturday, 6th January, 1962.

A. C. AYLWARD,
Clerk of the County Council.

County Buildings,
Huntingdon.

3225

# Ferranti transformers

have a vacancy for a

# DESIGN ENGINEER

for work on

## CONTROL PROBLEMS related to TRANSFORMERS
## and associated equipment

Applicants should have a degree or Higher National Certificate in electrical engineering.

This appointment is one which will offer A HIGH LEVEL OF TECHNICAL INTEREST & INDIVIDUAL RESPONSIBILITY, together with an attractive salary, good Pension and Dependants' Insurance benefits. The successful candidate will be joining the foremost British transformer manufacturing company with advantages of:—

- ★ **THE MOST UP-TO-DATE DESIGN AND DEVELOPMENT FACILITIES**
- ★ **TECHNICAL LEADERSHIP**
- ★ **A MANUFACTURING CAPACITY OF OVER 5,000,000 kVA PER ANNUM**
- ★ **WORLD-WIDE INTERESTS**

**Application forms can be obtained from T. J. Lunt, Staff Manager, Ferranti Limited, Hollinwood, Lancs. Please quote reference LP.**

3260

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## 'ENGLISH ELECTRIC'
## PUBLICITY DEPARTMENT

A VACANCY occurs in the Information Section of the Publicity Department at Stafford. The duties include dealing with requests for information on the company and its products from a wide variety of sources and the editing of technical sales brochures. The post will appeal to those with a minimum of O.N.C. or alternatively an arts degree.

Stafford is a pleasant county town in a green belt, within easy reach of Wolverhampton, Birmingham and Stoke-on-Trent.

The post carries admission to the company's staff pension scheme, and three weeks' holiday, after a qualifying period.

Please apply, giving details of age, previous experience and salary expected, to :—

**The Deputy Publicity Manager**
**THE ENGLISH ELECTRIC CO. LTD.**
**Foregate Street Offices, Stafford**

3275

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## DRAUGHTSMEN

SEVERAL Draughtsmen are required for the mechanical developments of electric motors, A.C. and D.C., shafts, frames, end brackets, etc. Experience of flameproof motor design an advantage. Good wages; pension scheme; 5-day week.

Box 3218

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## AN ESTIMATOR
for
## TEMPERATURE CONTROL PANELS

is required by

**THE RHEOSTATIC CO. LIMITED OF SLOUGH**

to supervise the section in the Home Sales Department dealing with the cost estimation of Control Panels and also to assist in the management of the Panel department generally.

Experience in the design and manufacture of control panels is essential, with possession of relevant technical qualifications.

This aspect of the company's business is rapidly expanding, affording scope and opportunity to the successful applicant.

The company operate a generous life assurance and pension scheme.

Please apply to the

**Personnel Manager** 3283

---

A LARGE company of electrical engineers and contractors have a vacancy for a supervising engineer at their head office in Westminster. A bonus scheme is in operation, also a non-contributory pension scheme for those under the age of fifty years when joining the staff. Engineers with qualifications to enable them to undertake the supervision of the largest contracts are requested to apply, stating details of experience, age and present salary, to—Box 3282.

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ELECTRICAL contractors require experienced storekeeper. Must have knowledge of trade. Opportunity for right man to join expanding firm. — Service Electric Co. Ltd., Secomak Works, Honeypot Lane, Stanmore, Middx. (EDGware 5566). 3140

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## BRITMAC ELECTRICAL COMPANY LTD.

**Manufacturers of**
**High-Class Electrical Accessories**

require a

## REPRESENTATIVE

for the Counties of CUMBERLAND, WESTMORLAND, LANCASHIRE, CHESHIRE and NORTH WALES.

Candidates must have good connections with consulting engineers, local authorities, electrical contractors and wholesalers.

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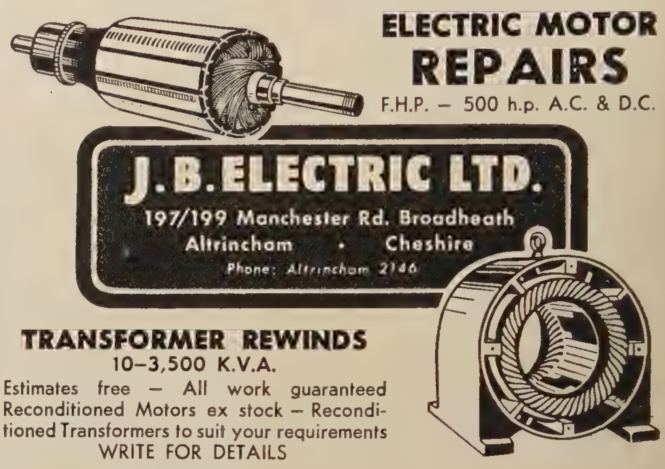
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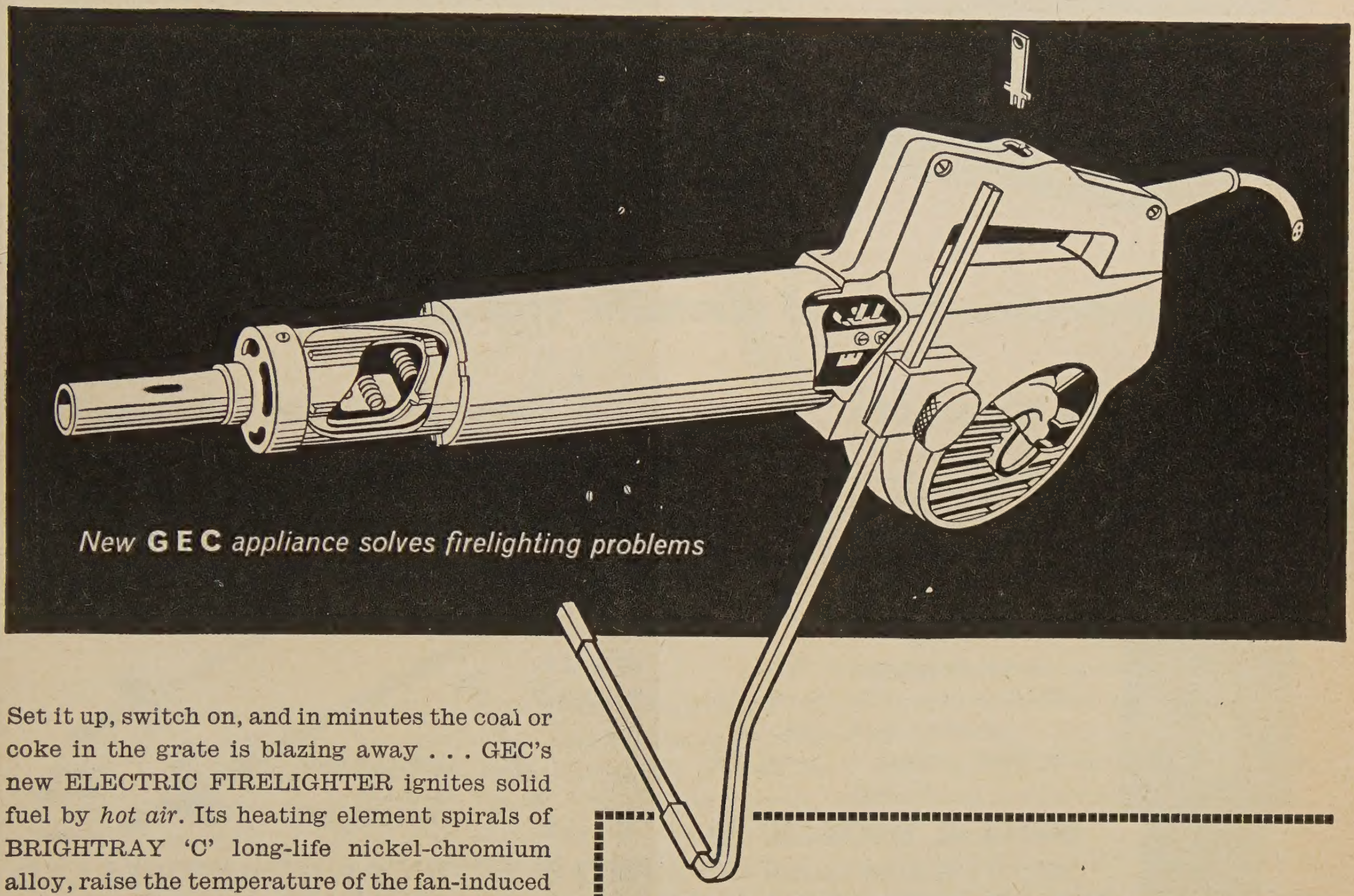

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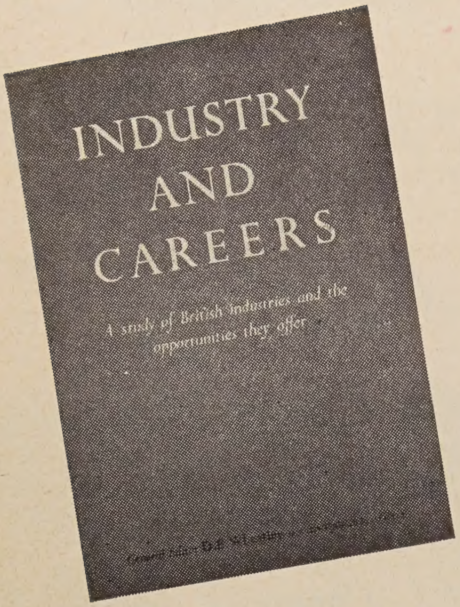
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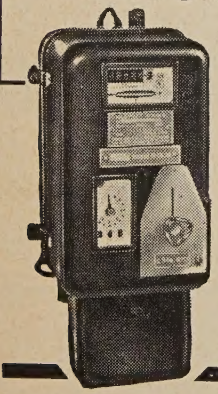

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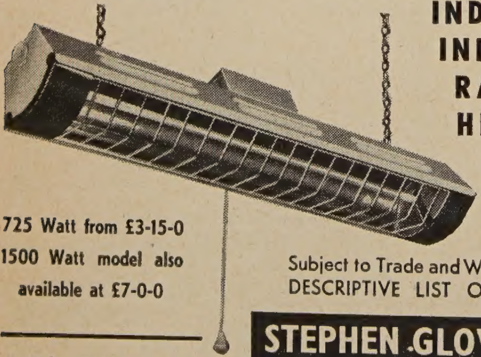

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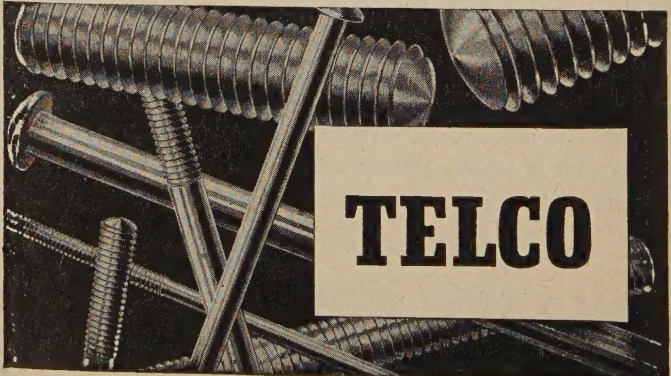

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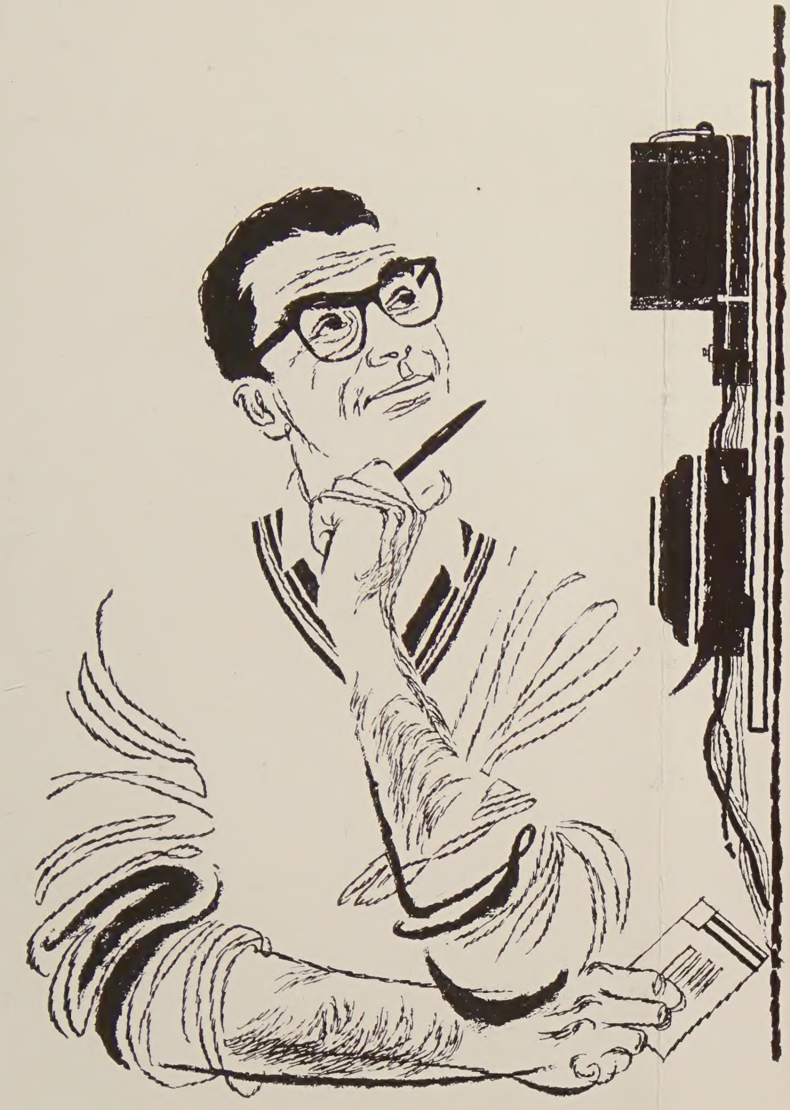

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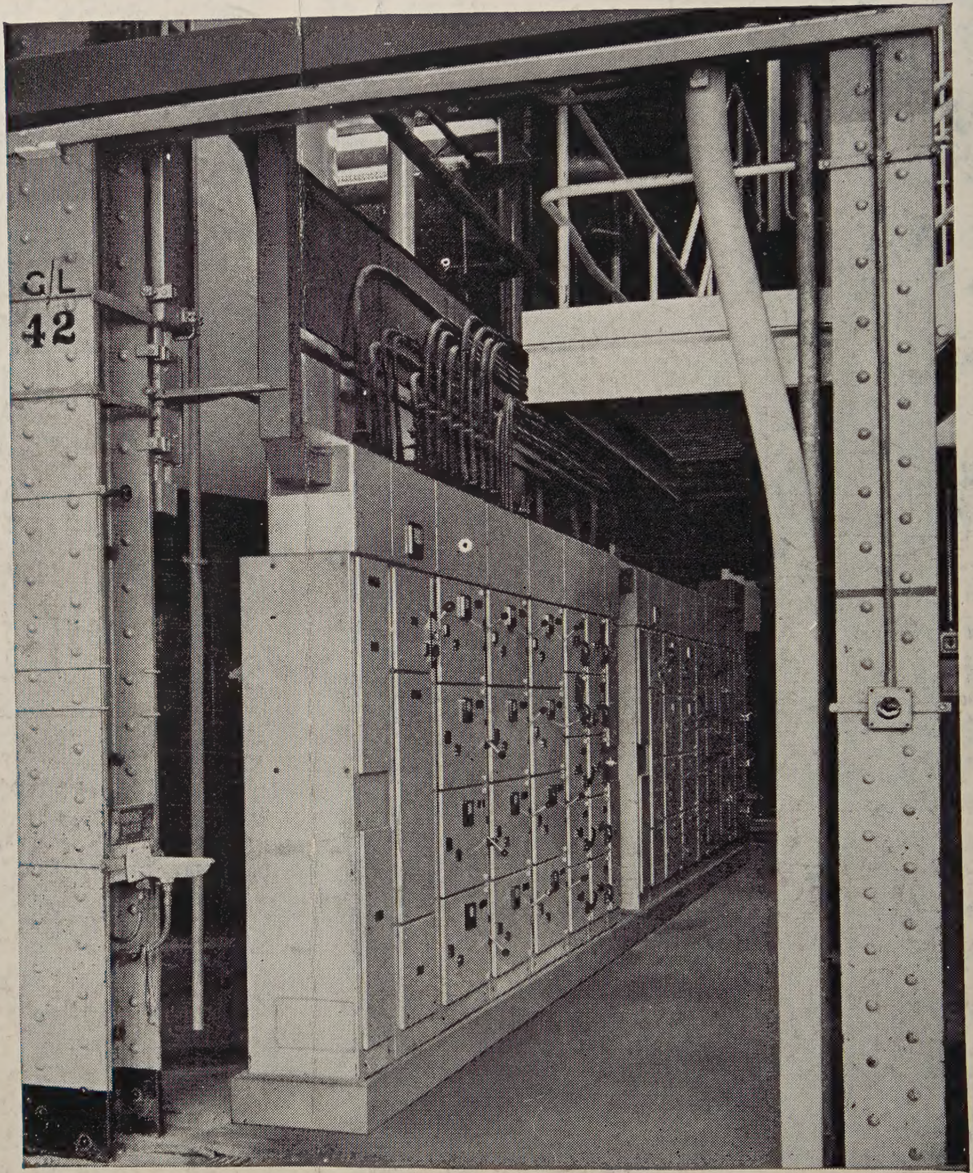

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